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OUR CINCINNATI OFFICE

The Simmons-Boardman Publishing Company, publisher of the *Railway Mechanical Engineer,* has opened an office in the First National Bank Building, Cincinnati, Ohio. It will be in charge of R. H. Smith, a member of the business staff formerly connected with our Chicago office, who will look after the interests of the Simmons-Boardman publications, including the *Railway Mechanical Engineer,* Railway Age, Railway Maintenance Engineer, Railway Signal Engineer, Railway Electrical Engineer and the Locomotive and Car Builders' Dictionaries.

Tender Tanks Need Stronger Bracing

One of the common results of collision is to cause the tender tank to slide forward off the underframe, demolishing the cab and in some cases injuring the enginemen. While such accidents are not of frequent occurrence, it is important that every precaution should be taken to prevent personal injuries in such circumstances and for that reason it would seem advisable to fasten tender tanks to the frame in a manner that would prevent the shifting of the tank, at least in so far as it can be avoided in minor collisions. The types of fastenings generally used on rectangular tanks have evidently not been designed with that end in view, but are intended rather to withstand only the pressure occasioned by the shifting of water resulting from brake applications. The weight of the contents of a large tender when fully loaded is more than 100,000 lb. yet this great mass is often secured to the underframe by six or eight bolts 7/8-in. in diameter. This criticism of the fastenings used on tenders does not apply with equal force to cylindrical tanks as they are usually set between headblocks which effectually prevent any shifting. On tenders with rectangular tanks, however, increased safety could no doubt be secured by the use of heavier braces to secure the tanks to the underframe or by forming a depression in the underframe into which the tank could be set.

Railroad Y. M. C. A. Extension

The Railroad Y. M. C. A. is about to enter a national extension movement that promises to double or triple its effectiveness within the next year. There are now about 300 Railroad Y. M. C. A.'s in this country and Canada. The greater part of their energies has been devoted to looking after the physical needs of the trainmen; and the practical results, in the way of increased safety and more efficient operation, are recognized by hard-headed railroad officers throughout the country. Some of the associations have given considerable attention to the needs of shopmen also, and not a few of them have been developed into community centers. The Railroad Y. M. C. A. believes, however, that it has a duty to perform for every individual on the railroads, although they may not be able to use the buildings in the same way as do the men in the train service. There is a big field, for instance, for educational work among certain classes of employees. There is real need in many places for an Americanization program. Many believe that the Railroad Y. M. C. A., with its physical experts, can be a strong factor in helping to develop system athletics and also to carry on a more extended program looking toward the physical needs of the individuals. There are many other phases of the work that might be extended to advantage.

The present extension movement includes a membership

campaign this month and a series of campaigns during the fall in order thoroughly to organize the work in all departments for the next year. The extension movement is being very carefully planned, and one interesting development is that the railroad men, themselves, are taking the most aggressive part in promoting it; the secretarial staff is being used largely in an advisory capacity. The importance of this development in the success of the movement can be readily recognized by those who have given critical attention to the various aspects of the industrial problem, particularly so far as they relate to the so-called welfare work or the matter of relations between employers and employees.

Inspection and Test Section Draft Gear Tests

At the invitation of the Inspection and Test Section of the Railroad Administration about 60 representatives of draft gear manufacturers, railroad men and others interested in the draft gear subject, witnessed a series of unofficial demonstrations at the draft gear testing plant of the T. H. Symington Company, Rochester, N. Y., in which was set forth a unique method of recording the action of draft gears under impact between two cars. The purpose of the demonstrations was to give all those interested an opportunity to study the recording apparatus and the methods used in advance of the official tests to be conducted by the Test Section on practically all the well-known types of draft gears. Aside from the unique method of graphically recording the action of the gears under impact, a description of which appears elsewhere in this issue, the outstanding feature of the demonstrations was the spirit of fairness and frankness with which constructive criticism and suggestions were requested and received by those in charge of the tests.

The series of tests under approximately service conditions, which are to follow the public demonstrations, are a part of a program in which complete comparative studies of the various draft gears are to be made. The work so far outlined is dealing with new gears. This, however, is but one phase of the whole draft gear problem. What is required in service is not only a gear possessing the nearest approach to ideal characteristics, but one which maintains throughout a reasonable service life the nearest approach to ideal characteristics. An investigation of this phase of the subject is one requiring a large amount of time and effort over a period of years. The draft gear committee of the Master Car Builders' Association, which is co-operating with the Inspection and Test Section, has been and is investigating this phase of the subject, and it seems reasonable to expect as the result of the efforts of the two co-operating agencies that results of great value eventually will be obtained.

The Mechanical Conventions

The Master Car Builders' Association and the American Railway Master Mechanics' Association will this year meet as the Mechanical Section of the American Railroad Association. The convention, which is to be held at Atlantic City the latter part of June, promises to be the largest and most successful one ever held. The reports will be out early so that the members can digest them before going to the meetings. The Railroad Administration is lending its full aid and support in order to have a representative attendance. The exhibit space, although it has been greatly increased over that required in the record-breaking year, 1913, promises to be inadequate.

The mechanical department officers and foremen should, of course, plan to take full advantage of this convention which has been discontinued since 1916 because of the war. On the other hand, they must recognize that they are on trial and that they will be closely watched not only by the Railroad Administration, but by the higher executive officers. They have a real opportunity to put the mechanical association on a much higher plane than was ever thought of in the past because it will now be possible to pass on its recommendations to the American Railroad Association and to have them made effective, if approved, by the Railroad Administration. Will the mechanical department officers grasp this opportunity and make full use of it?

Various suggestions have been made as to how each road may get the most from meetings of this sort. One of the best is that every man who is sent to the conventions be asked to report in writing those things that came to his attention that he thinks can be applied to good advantage on his own road. It may be that the suggestions will spring from some report presented to the convention or from the open discussion of it. It may be that the exhibits will suggest something or possibly the informal discussions, at the table, in the hotel, or on the train with officers of other roads, or with railway supply experts. If several men are sent from one road, it would seem wise to have each one instructed to investigate those problems which he is best fitted by experience and training to study. Is it not about time for the railroads to make scientific use of meetings of this kind and definitely to plan to get the utmost return from them?

Modernizing Stationary Power Plants

The intensive fuel conservation campaign that has been carried on during the past two years has caused the railroads to give more attention to the condition of stationary power plants. The result has been a remarkable increase in the efficiency of such plants, which many roads had formerly neglected. These economies were effected under the stress of war conditions, but the officers of the railroads should take effective measures to insure the continuance of the splendid performance now being secured. One of the reasons that the condition of stationary power plants was neglected in the past was that the roads had no special organization to supervise their operation but left it in the hands of the general foremen who were primarily shop executives and could hardly be expected to be authorities on the economical operation of power plants. It is evident that an organization charged with the responsibility for maintaining the condition of power plants at a high standard is needed to secure the best results and such a staff should be organized on every road, if it has not already been formed.

The mere fact that a power plant is operating at higher efficiency than ever before does not prove that the plant itself is efficient. During the war it was necessary to keep uneconomical equipment in service because new engines and boilers could not be secured. That difficulty has now been removed and it is advisable at this time to investigate the possibilities of saving by the redesign of existing installations. The question should be considered in the light of present conditions as conclusions based on data secured when lower wages and prices prevailed are sure to be misleading. Far larger expenditures to effect a given saving are justified now because of the great increase in the cost of fuel. There are many railroad power plants operating today with old boilers, perhaps taken from obsolete locomotives, and uneconomical reciprocating engines. In such cases it would almost invaribly prove advisable to install modern boilers and turbines. Aside from the reduction in fuel cost, there is often an opportunity for further saving by a reduction in the number of attendants required at the power house. This is especially true where large shops are supplied with power from several small plants. Such installations though not uncommon represent the extreme in the inefficient utilization of both fuel and labor and should be replaced as rapidly as possible.

Fuel Conservation and the Movies

Moving pictures are not new in connection with educational work on the railroads. Possibly their most notable application in that field is in connection with the safety-first movement. The Pennsylvania Railroad has, however, gone outside of that field and has prepared some excellent films in connection with the maintenance of equipment, locomotive operation, etc. Moving pictures taken by the Northern Pacific in connection with its fuel conservation campaign were shown at the April meeting of the New York Railway Club. The western roads have always had more or less difficulty with their fuel supply and it has been necessary for them to study conservation methods to a greater extent than on roads in most of the other parts of the country.

A number of years ago the Northern Pacific equipped a fuel instruction car which has been sent back and forth over the system with excellent results. It is not an easy task to interest the average fireman or engineer in the theory of cumbustion and yet those in charge of this work on the Northern Pacific were able to develop a series of demonstrations that not only held the interest of the men, but inspired them to perform their work in such a way as to make the best use of the technical instruction that had been imparted to them. The management felt it necessary to intensify the fuel conservation educational work during the war because of the higher cost of fuel and the number of new men that it was necessary to employ on the locomotives. Careful consideration seemed to indicate that moving pictures could profitably be added to the equipment of the fuel instruction car in order to drive home and emphasize more forcefully the most important factors involved in an aggressive and successful fuel conservation campaign. Fortunately, those in charge recognized the necessity of having these pictures taken under the supervision of a moving picture expert and the results are really remarkable.

It is difficult at first thought to see how moving pictures could be used to demonstrate the advantages of single scoop firing, the abuses of popping, or the wastefulness in handling fuel. The moving picture expert and the fuel instruction expert working together have made it possible to tell the story simply and clearly and with the same effectiveness that is so characteristic of the high grade moving pictures. These pictures have been shown not only in the fuel instruction car on the Northern Pacific, but in various halls and meeting places at the more important cities and division points. When shown in the latter way, the townspeople are often invited to attend and are given suggestions as to the use of fuel in the home that have undoubtedly been productive of good results. An outline of how the work is carried out in detail on the Northern Pacific will be found elsewhere in this issue.

The Piece Work Question

Piece work is now a thing of the past on the railroads. There are those who believe that Director General McAdoo's order No. 8 was directly responsible for this because of the encouragement it gave to the extension of the union labor movement among railroad employees. The most important direct factor, however, was the increase in the hourly rate of the men without any corresponding increase in the piece work rates. It is contended by the Railroad Administration that there was so much dishonesty in the application of piece work that it was in the interests of the railroads to abolish it. Dishonesty, however, is something that cannot very well be instantly cured by rules or regulations. It is something that must be patiently dealt with through extended processes of education, in order to raise the moral standards of the individual or the group. It is doubtful, judging from various investigations that have been made, whether there is not an even greater amount of dishonesty under present conditions than could formerly have existed; this is indicated by the falling off in the productive output of the individual now that piece work has been abolished.

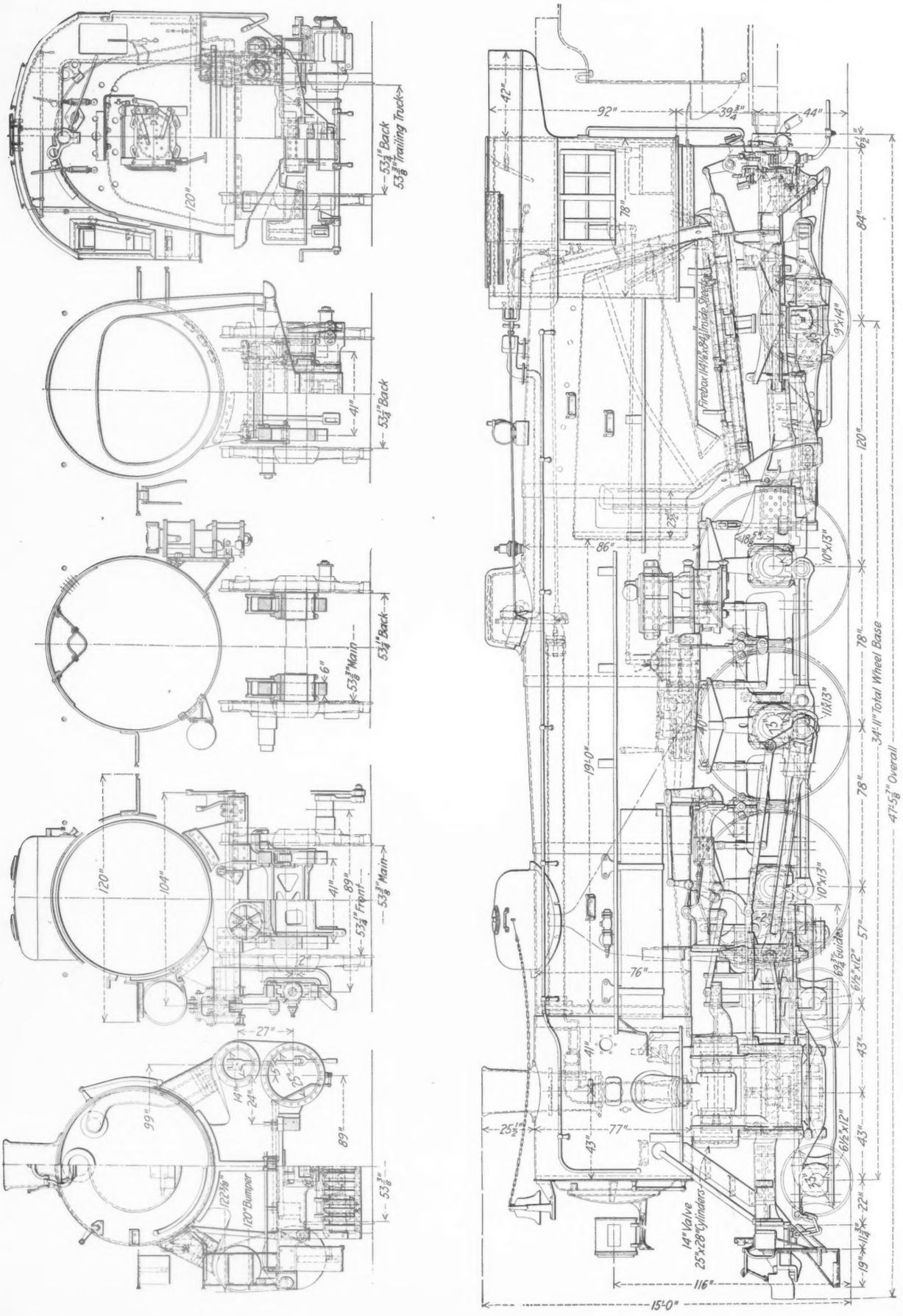
The important thing, however, at this time is not to lament the passing of piece work, but rather to study how to reorganize in such a way as to secure the best possible results under day work conditions. Manifestly, the supervision and practices and methods used formerly cannot give the best results under present conditions. Two things are absolutely vital to a successful solution of the problem. We almost hesitate to mention them, because, although the *Railway Mechanical Engineer* has advocated them for years, comparatively few railroad officers seem to have taken them seriously enough to make a real effort to promote them.

In the first place, a real, definite, aggressive effort must be made to educate not only the apprentices (and very few railroads have done this in the past), but also the men who have been in the service for long periods of time. Just because a man is classed as a mechanic, does not mean that he really understands how to do his job or knows the best way in which to do it. Very few things could be done with such telling results as to go at this matter in a serious way and utilize the best thought along these lines which has been developed in the industries and also in different branches of our army during the war. The next thing that should be done is to establish real schedules for doing the work, and this is particularly true in the locomotive repair shops. Not the least important result of the installation of such schedules is that weaknesses in the organization or defects in the methods and practices are automatically located and corrected. These suggestions are not theoretical. They are eminently practical and have been used with excellent results. It is unfortunate, however, that mechanical department officers as a whole have not had sufficient vision to recognize their value and to put them into effect.

NEW BOOKS

Proceedings of the International Railway Fuel Association. Edited by J. G. Crawford, secretary. 194 pages, 6 in. by 9 in., bound in leather. Published by the association, J. G. Crawford, secretary, 702 East 51st street, Chicago. Price, $1.50.

The tenth annual convention of the International Railway Fuel Association, which was held in Chicago last May, was an extremely important one, as it convened under the direct auspices of both the Railroad and Fuel Administrations. No better collection of railway fuel men was brought together at one gathering than at this convention. The papers read were not only inspiring, but full of great merit, and the prominence of the men that addressed the convention made these proceedings of great value. This book is a complete report of the convention and includes the following papers: Railroads and Their Relation to the Fuel Problem, by R. H. Aishton, regional director, U. S. R. A.; What the Canadian Railways Have Been Doing to Conserve Fuel, by Thomas Britt, general fuel agent, Canadian Pacific; Motive Power Men and Fuel Economy, by Robert Quayle, general superintendent motive power, Chicago & North Western; The Railroads' Industrial Army, by W. S. Carter, director, Division of Labor, U. S. R. A.; Relation of Locomotive Maintenance to Fuel Economy, by Frank McManamy, assistant director, Division of Operation, U. S. R. A.; Need for Fuel Conservation, by P. B. Noyes, director, Conservation Division, Fuel Administration; Fuel Oil and the War, by M. L. Requa, director, Oil Division, Fuel Administration; and Individual Effort Toward Fuel Saving, by Eugene McAuliffe of the Railroad Administration.

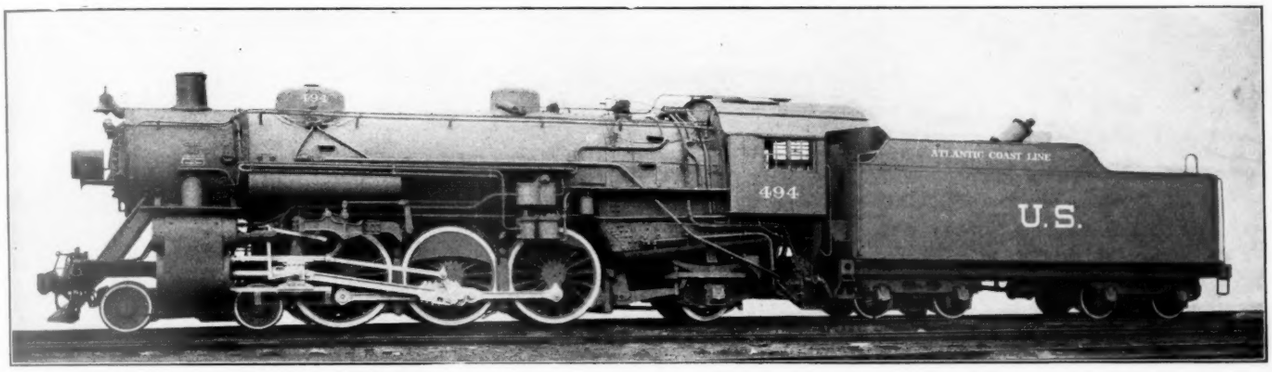


Elevation and Sections of the Standard Light Pacific Type Locomotive

STANDARD 4-6-2 TYPE LOCOMOTIVES

Both Light and Heavy Classes Have Many Details Interchangeable with the Other Standard Designs

THE first of the two classes of Pacific type locomotives built to the United States Railroad Administration's standard designs have recently been turned out of the Richmond Works of the American Locomotive Company, the light locomotive for delivery to the Atlantic Coast Line and the heavy locomotive for delivery to the Erie. The light locomotive is one of a total of 59 of these locomotives which have been ordered by the Railroad Administration, 26 to be built by the American Locomotive Company and 33 by the Baldwin Locomotive Works. Orders have been placed for a total of 20 of the heavy locomotives, 10 with each of the above mentioned builders.



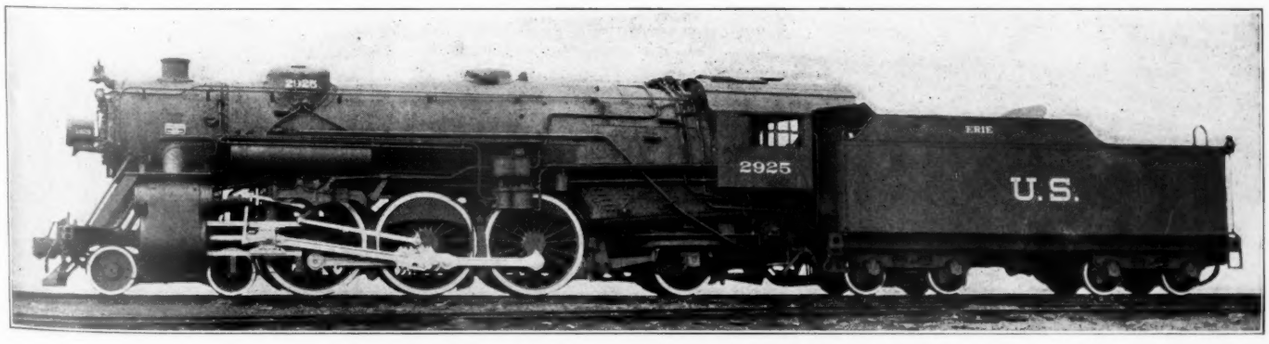
The Standard Light Pacific Type Locomotive

The light Pacific type was designed on the basis of driving wheel loads of 55,000 lb. per axle and has a total weight of 277,000 lb. in working order. The actual driving axle loads are 54,000 lb. each, and a tractive effort of 40,700 lb. is developed. In Table I will be found a comparison of this locomotive with a number of others of the same type designed on the basis of approximately the same axle loads. It will be seen that the standard locomotive is somewhat similar in its proportions to the Missouri, Kansas & Texas locomotive, which, however, has more heating surface, but a considerably smaller grate and a smaller ratio of firebox heating surface to total heating surface.

The design of the heavy Pacific locomotive was based on driving axle loads of 60,000 lb. The actual weight on drivers, however, is 197,000 lb., equivalent to slightly less than an average of 66,000 lb. on each axle. The total weight of this locomotive in working order is 306,000 lb. and it has a maximum tractive effort of 43,900 lb.

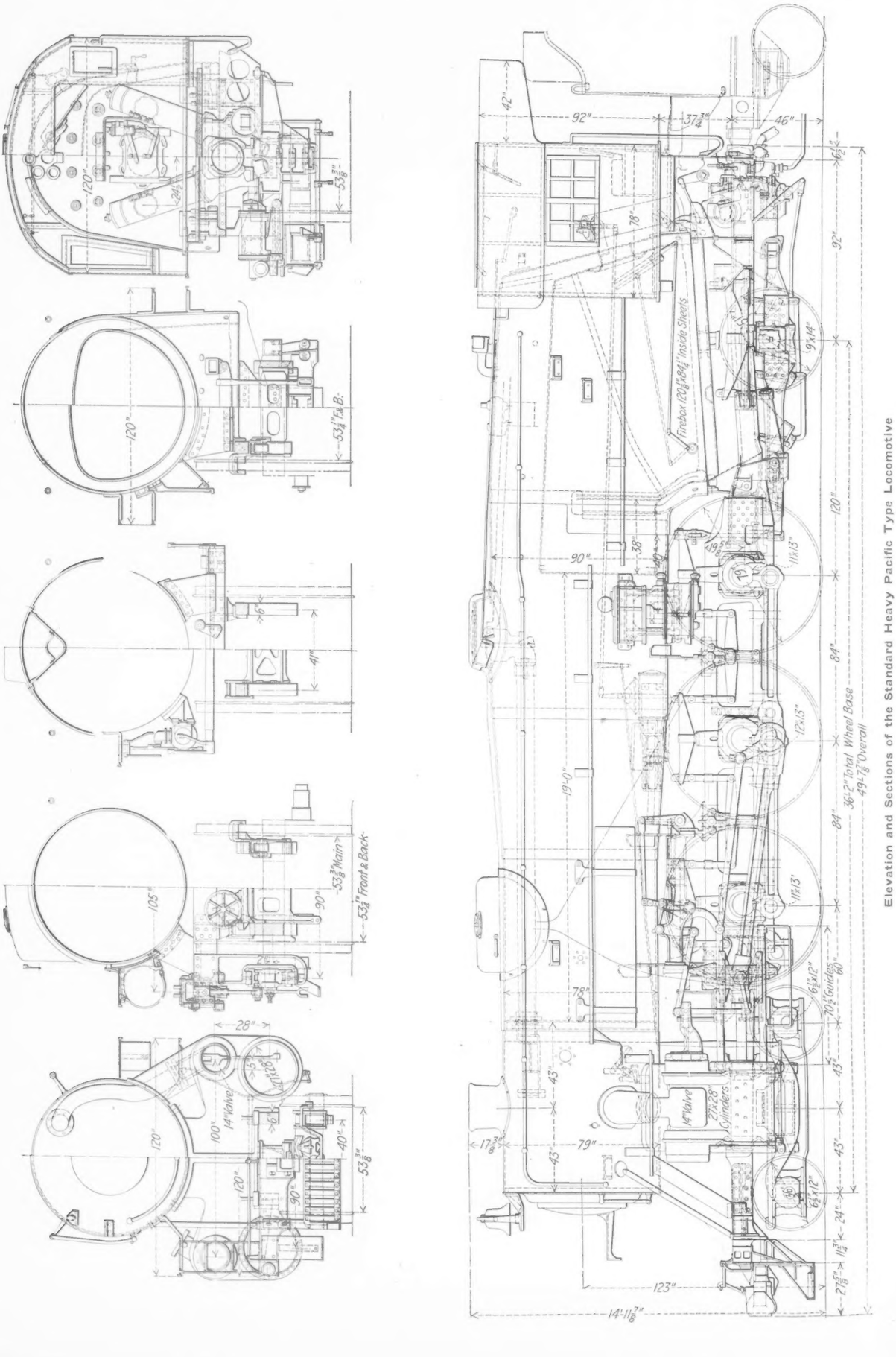
In Table II will be found a comparison of this locomotive with several other heavy Pacific type locomotives. The heavy standard locomotive compares more closely with the Pennsylvania K4s Pacific than with any of the others. It has about 4,000 lb. less weight on drivers than the Pennsylvania locomotive, with a total weight 3,000 lb. less, and on a comparative basis is rated at 600 lb. less starting tractive effort. A comparison of the heating surfaces of the two locomotives would indicate that the Pennsylvania locomotive had a considerably greater capacity for high sustained speed when handling similar loads.

The boilers of the two standard Pacific type locomotives are generally similar in construction, both being of the conical wagon top type with combustion chamber fireboxes. The outside diameter at the first ring of the two boilers is 76 in. and 78 in., respectively, increasing to 86 in. and 90 in., respectively, at the dome course. The light locomotive has 188 2¼-in. tubes and 36 5½-in. flues, while the heavy locomotive has 216 tubes and 40 flues of the same diameters. The tubes of both locomotives are 19 ft. long, while the combustion chamber of the light locomotive is 23½ in. long and that of the heavy locomotive 38 in. long. The maximum diameter of the boilers at the dome course is 86 in. for the light locomotive and 90 in. for the heavy locomotive. The light locomotive is hand fired, while the heavy engine is equipped with a Duplex stoker.



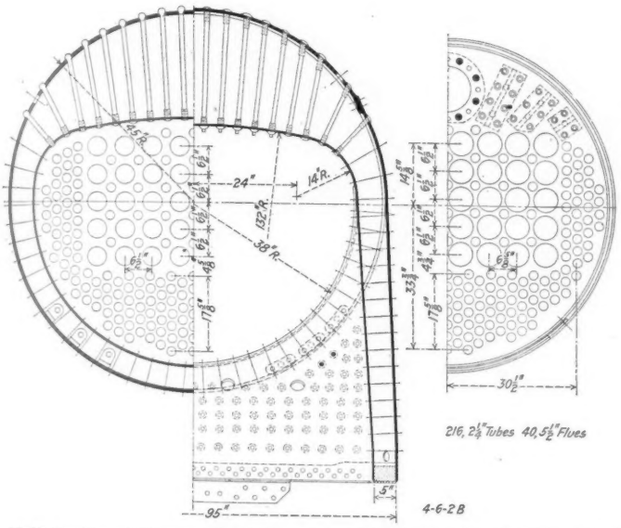
The Railroad Administration Standard Heavy Pacific Type Locomotive

Elevation and Sections of the Standard Light Pacific Type Locomotive



Elevation and Sections of the Standard Heavy Pacific Type Locomotive

The design of the frames for both types is essentially the same. Both are of the single front rail type, each frame being cast in one piece with a splice back of the rear driving wheels for Commonwealth cradle castings. In both cases the frames are six inches wide. The lighter frames have a depth of top rail of 6⅛ in. over the driving boxes and a minimum depth of 5⅛ in. between the drivers. The maximum and minimum depths of the lower rail are 4¼ in. and 3¾ in., respectively. The frames for the heavy Pacific have a depth over the driving boxes of 7⅛ in. and a minimum depth of top rail of 6 in., while the maximum and minimum depths of the lower rail are 4¾ in. and 4¼ in., respectively.



Half Sectional Views of the Firebox and Combustion Chamber and Half Tube Sheet Elevation

The cylinders of both types are similar in design to those on all of the other single unit standard locomotives and both are designed for the use of 14-in. piston valves. Those of the light Pacific type are 25 in. in diameter, while the heavy locomotives have 27-in. cylinders, the stroke being 28 in. in both cases. The pistons are of the single plate dished type, the specifications calling for either cast or rolled steel, with a cast iron bull ring and packing rings of Hunt-Spiller gun iron. In both cases the cylinders and valve chambers are fitted with the Hunt-Spiller gun iron bushings. The piston and rod of the light Pacific type are interchangeable with those of the eight-wheel switcher, while the piston on the heavy Pacific type interchanges with that used on the heavy Mikado and Mountain type locmotives and the light Santa Fe type. The crosshead is also essentially the same as that used on all the other locomotives and that of the light Pacific interchanges with the crosshead of the eight-wheel switcher and the light Mikado type locomotive. While none of the cylinder designs are interchangeable, the front and back heads have been made interchangeable where the diameter of the cylinders is the same, those for the light Pacific interchanging with the Eight-wheel switcher, and those for the heavy Pacific interchanging with the heavy Mikado and the light Santa Fe and Mountain type locomotives.

Table I—Comparison of Light Pacific Type Locomotives

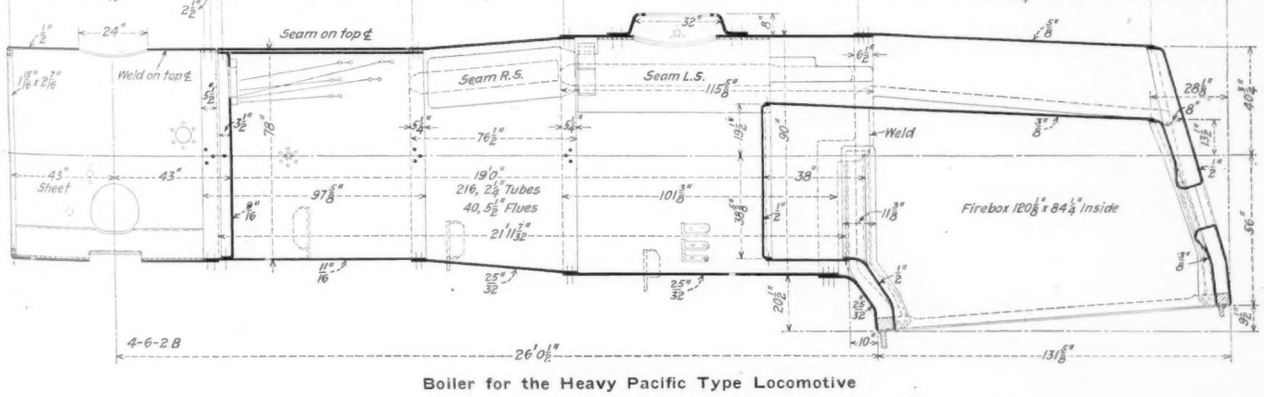
Road	U. S. R. A.	M. K. & T.	C. B. & Q.	N. Y. N. H. & H.
Year built	1919	1915	1915	1916
Tractive effort, lb.	40,700	40,700	42,000	40,800
Total weight, lb.	277,000	272,000	266,400	266,000
Weight on drivers, lb.	162,000	165,000	169,700	165,000
Diameter, drivers, in.	73	73	74	79
Cylinders, diameter and stroke in.	25 by 28	25 by 28	27 by 28	26 by 28
Boiler pressure, lb.	200	200	180	200
Heating surface, total, sq. ft.	3,333	3,838	3,364	3,315
Superheating surface, sq. ft.	794	870	751	776
Grate area, sq. ft.	66.7	57.5	58.7	59.2
Tractive effort × dia. drivers ÷ equivalent heating surface	656.7	577.0	693.0	719.6
Equivalent heating surface ÷ grate area	67.8	89.5	76.4	75.7
Firebox heating surface ÷ equivalent heating surface, per cent	5.8	4.8	6.5	6.7

Table II—Comparison of Heavy Pacific Type Locomotives

Road	U. S. R. A.	P. R. R.	D. L. & W.	L. V.
Year built	1919	1914	1915	1916
Tractive effort, lb.	43,900	44,500	47,506	48,800
Total weight, lb.	306,000	308,900	305,000	301,500
Weight on drivers, lb.	197,000	201,800	197,300	192,200
Diameter drivers, in.	79	80	73	73
Cylinders, dia. and stroke, in.	27 by 28	27 by 28	27 by 28	27 by 28
Boiler pressure, lb.	200	205	200	205
Heating surface, total, sq. ft.	3,824	4,035	3,680	4,103
Superheating surface, sq. ft.	887	1,154	760	75
Grate area	70.8	70	91.3*	75
Tractive effort × dia. drivers ÷ equivalent heating surface.	672.9	580.6	719.4	639.2
Equivalent heating surface ÷ grate area	72.8	82.3	52.8	74.3
Firebox heating surface ÷ equivalent heating surface, per cent	6.3	5.0	7.7	6.6

*For anthracite coal.

Both the main and side rods are of channel section, the rod design for all of the standard locomotives being the same in details with the exception of the necessary variation in dimensions. The two Pacific type locomotives are the only ones having the channel section side rods, the others all being of slab section.

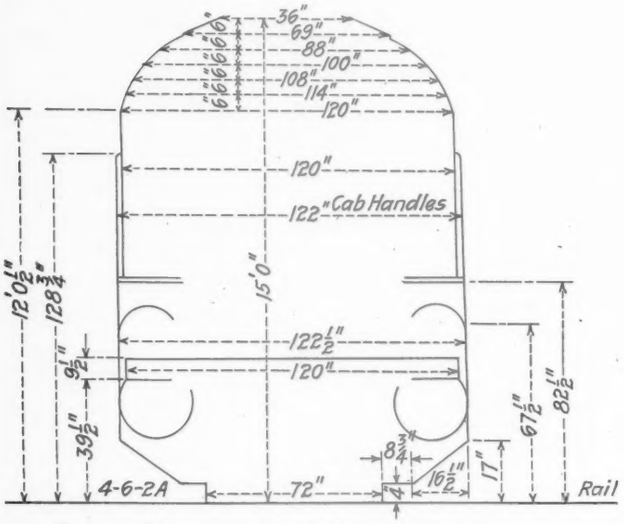


Boiler for the Heavy Pacific Type Locomotive

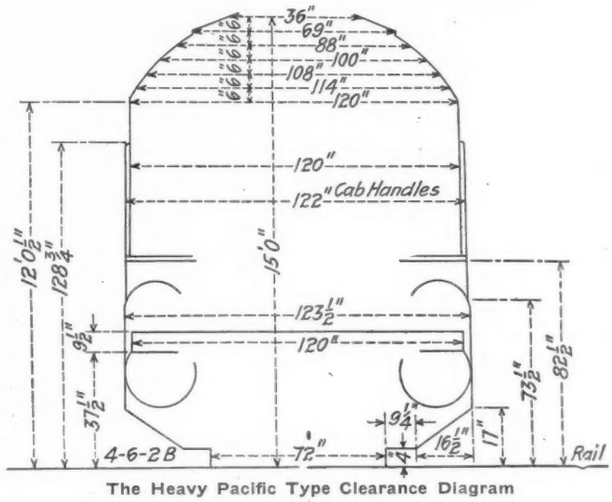
Wherever the journal sizes permit, the driving boxes have been made interchangeable on all of the locomotives. The light Pacific type locomotive has main journals 11 in. in diameter by 13 in. in length, while the front and back journals are one inch less in diameter. The front and back

driving journals of the heavy Pacific are the same size as those of the main journals on the light Pacific, while the main journals of the heavier locomotive are 12 in. in diameter by 13 in. in length.

Both locomotives have the constant resistance type engine truck with 6½-in. by 12-in. journals and 33-in. wheels, while the trailer trucks are of the Cole-Scoville design with 43-in. wheels and 9-in. by 14-in. journals. A considerable degree of interchangeability exists between the details of this type of truck in use on the standard Mountain and Pacific type locomotives, although complete interchangeability of the trucks as a whole has not been maintained in every case.



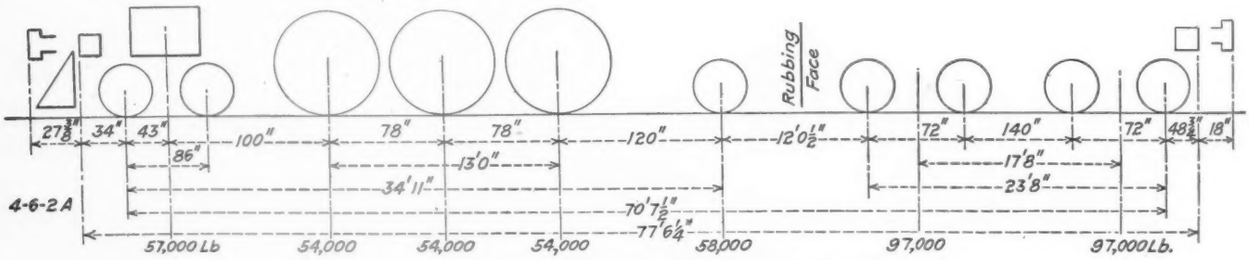
Clearance Diagram for the Light Pacific Type Locomotive



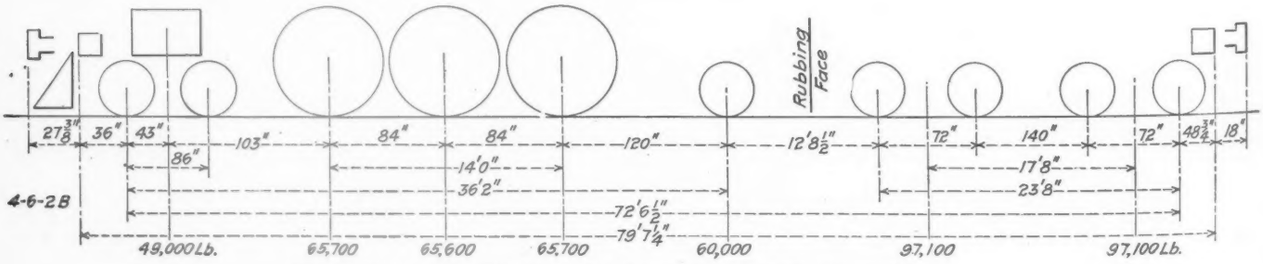
The Heavy Pacific Type Clearance Diagram

interchangeability has been carried throughout the various standard designs, including a large number of minor details, such as rod brasses, grate frames, bumper beams, many of the small castings, and in a number of cases, crank pins, axles and springs as well. A complete list of the specialties on all of the standard locomotives was published in the March, 1919, issue of the *Railway Mechanical Engineer*, on page 137.

Tonnage rating charts are shown, which were prepared by H. S. Vincent, and the clearance and wheel load diagrams were prepared by F. P. Pfahler, chief mechanical engineer, division of operation, of the Railroad Administration. The distribution of wheel loads as shown are actual weights of the completed locomotives.



Distribution of the Weight of the Light Pacific Type Locomotive



Distribution of the Weight of the Heavy Pacific Type Locomotive

The tenders of both locomotives are built with Commonwealth cast steel frames and have tanks of 10,000-gal. capacity. The tender trucks for both are of the Commonwealth equalized type, differing from the trucks under the heavy Mountain type, which were equalized swing motion trucks of the locomotive builder's design.

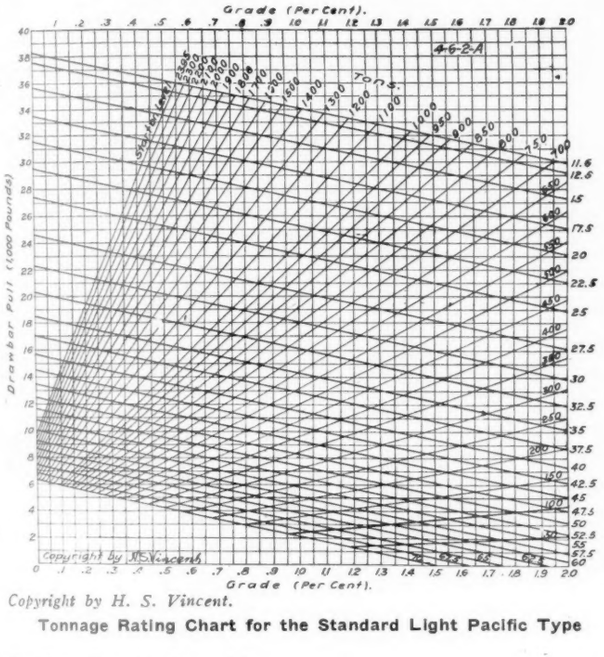
Aside from the parts already mentioned a large measure of

The principal dimensions and data for the two Pacific type locomotives are as follows:

General Data

	Light 4-6-2	Heavy 4-6-2
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Passenger	Passenger
Fuel	Bit. coal	Bit. coal
Tractive effort	40,700 lb.	43,900 lb.
Weight in working order	277,000 lb.	306,000 lb.

Weight on drivers	162,000 lb.	197,000 lb.
Weight on leading truck	57,000 lb.	49,000 lb.
Weight on trailing truck	58,000 lb.	60,000 lb.
Weight of engine and tender in working order	471,000 lb.	500,200 lb.
Wheel base, driving	13 ft.	14 ft.
Wheel base, total	34 ft. 9 in.	36 ft. 2 in.
Wheel base, engine and tender	68 ft. 7½ in.	70 ft. 8½ in.
Ratios		
Weight on drivers ÷ tractive effort	4.0	4.5
Total weight ÷ tractive effort	6.8	7.0



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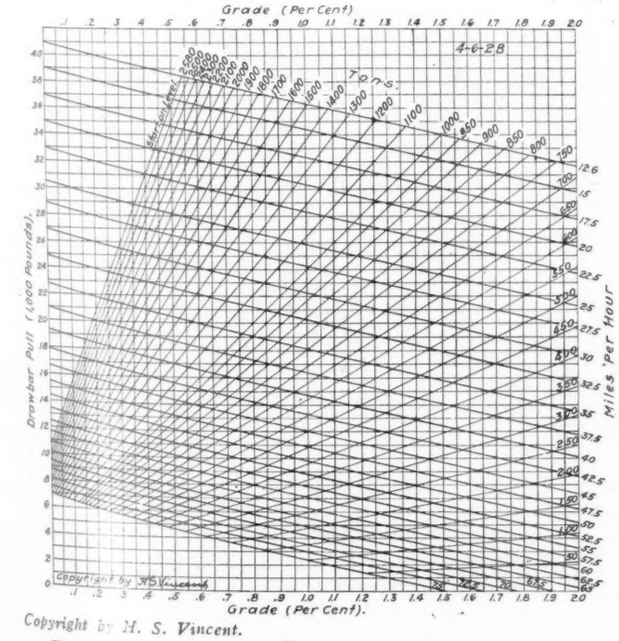
Tonnage Rating Chart for the Standard Light Pacific Type

Tractive effort × diam. drivers ÷ equivalent heating surface*	656.7	672.9
Equivalent heating surface* ÷ grate area	67.8	72.8
Firebox heating surface ÷ equivalent heating surface.* per cent.	5.8	6.3



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Tonnage Rating Chart for the Standard Heavy Pacific Type

Weight on drivers ÷ equivalent heating surface*	35.8	38.2
Total weight ÷ equivalent heating surface*	61.2	59.4
Volume both cylinders	15.0 cu. ft.	18.6 cu. ft.
Equiv. heat. surface* ÷ vol. cyls.	284.4	277.1
Grate area ÷ vol. cylinders	4.2	3.8

Cylinders		
~~Kind~~	Simple	Simple
Diameter and stroke	25 in. by 28 in.	27 in. by 28 in.
Valves		
~~Kind~~	Piston	Piston
~~Diameter~~	~~14 in.~~	~~14 in.~~
Wheels		
Driving, diameter over tires	73 in.	79 in.
Driving journals, main, diameter and length	11 in. by 13 in.	12 in. by 13 in.
Driving journals, others, diameter and length	10 in. by 13 in.	11 in. by 13 in.
Engine truck wheels, diameter	33 in.	36 in.
Engine truck, journals	6½ in. by 12 in.	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.	43 in.
Trailing truck, journals	9 in. by 14 in.	9 in. by 14 in.
Boiler		
Style	Con. W. T.	Con. W. T.
Working pressure	200 lb. per sq. in.	200 lb. per sq. in.
Outside diameter of first ring	76 in.	78 in.
Firebox, length and width	114⅛ in. by 84¼ in.	120⅛ in. by 84¼ in.
Firebox plates, thickness	Tube, ½ in.; others, ⅜ in.	Tube, ½ in.; others, ⅜ in.
Firebox, water space	Front, 5 in.; others, 4 in.	Front, 5 in.; others, 4 in.
Tubes, number and outside diameter	188—2¼ in.	216—2¼ in.
Flues, number and outside diameter	36—5½ in.	40—5½ in.
Tubes and flues, length	19 ft. 0 in.	19 ft. 0 in.
Heating surface, tubes	2,091 sq. ft.	2,407 sq. ft.
Heating surface, flues	981 sq. ft.	1,090 sq. ft.
Heating surface, firebox†	261 sq. ft.	327 sq. ft.
Heating surface, total	3,333 sq. ft.	3,824 sq. ft.
Superheater heating surface	794 sq. ft.	887 sq. ft.
Equivalent heating surface*	4,524 sq. ft.	5,154 sq. ft.
Grate area	66.7 sq. ft.	70.8 sq. ft.
Tender		
Tank	Water Bot.	Water Bot.
Frame	Cast Steel	Cast Steel
Weight	194,000 lb.	194,200 lb.
Water capacity	10,000 gal.	10,000 gal.
Coal capacity	16 tons	16 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
† Includes arch tube heating surface.

I. C. C. REVISES LOCOMOTIVE INSPECTION RULES

On September 20, 1917, the Interstate Commerce Commission issued an order putting into effect a number of modifications and suspensions of the locomotive inspection rules. The changes were made at the request of the railroads because of the difficulty of meeting some of the requirements of the rules with a shortage of competent labor and a lack of sufficient material, without seriously curtailing the supply of motive power to handle the extraordinary traffic movement required to supply the war needs of the country. Since the signing of the armistice the readjustment of the industrial activities of the country and the demobilization of the army have changed the conditions which the modifications in the rules were intended to meet. An order reciting these facts, effective May 1, 1919, has been issued canceling the order of September 20, 1917, but making permanent such of the provisions of that order as experience has demonstrated may be made permanent without adversely affecting the safety of operation.

The new order modifies Rules 2, 10, 16, 23, 110, 112, 128, 142 and 150 to read as follows:

Rule 2—The lowest factor of safety for locomotive boilers, which were in service or under construction prior to January 1, 1912, shall be 3.25.

Effective October 1, 1919, the lowest factor shall be 3.5.

Effective January 1, 1921, the lowest factor shall be 3.75.

Effective January 1, 1923, the lowest factor shall be 4.

Rule 10. *Flues to be Removed*—All flues of locomotive boilers in service, except as otherwise provided, shall be removed at least once every four years for the purpose of making a thorough examination of the entire interior of the boiler and its bracing. After the flues are taken out, the inside of the boiler must have the scale removed and be thoroughly cleaned and inspected. The removal of flues will be due after 48 calendar months' service, provided such service is performed within five consecutive years. Portions of calendar months out of service will not be counted. Time out of service must be properly accounted for by out of service reports and notations of months claimed out of service made on the back of each subsequent inspection report and cab card. The period for removal of flues, upon formal application to the chief inspector, may be extended, if investigation shows that conditions warrant it.

Rule 16. *Lagging to be Removed*—The jacket and lagging shall be removed at least once every five years and a thorough inspection made of the entire exterior of the boiler while under hydrostatic pressure. The

jacket and lagging shall also be removed whenever on account of indications of leaks the United States inspector or the railroad company's inspector considers it desirable or necessary.

The modification granted in Rule 16, in the Commission's Order of September 20, 1917, on account of the war, in which the date for removal of jacket and lagging was advanced for a period equivalent to the duration of the war, such advanced period shall be considered two years.

Rule 23. *Method of Testing Flexible Staybolts with Caps*—All flexible staybolts having caps over the outer ends shall have the caps removed at least once every two years, and also whenever the United States inspector or the railroad company's inspector considers the removal desirable in order to thoroughly inspect the staybolts.

The firebox sheets should be examined carefully at least once a month to detect any bulging or indications of broken staybolts. Each time a hydrostatic test is applied, the hammer test required by Rules 21 and 22, shall be made while the boiler is under hydrostatic pressure, not less than the allowed working pressure, and proper notation of such test made on Form No. 3.

Rule 110. *Time of Cleaning*—Distributing or control valves, reducing valves, triple valves, straight-air double-check valves and dirt collectors shall be cleaned as often as conditions require to maintain them in a safe and suitable condition for service, but not less frequently than once every six months.

Rule 112. (*a*). *Piston Travel*—The minimum piston travel shall be sufficient to provide proper brake shoe clearance when the brakes are released.

(*b*). The maximum piston travel when locomotive is standing shall be as follows:

Cam type of driving wheel brake	3½ in.
Other forms of driving wheel brake	6 in.
Engine truck brake	8 in.
Tender brake	9 in.

Rule 128 (a). *Rods, Main and Side*—Cracked or defective main or side rods shall not be continued in service.

(*b*) Autogenous welding of broken or cracked main and side rods not permitted.

(*c*) Bearings and bushings shall so fit the rods as to be in a safe and suitable condition for service, and means be provided to prevent bushings turning in rod. Straps shall fit and be securely bolted to rods.

(*d*) The total amount of side motion of rods on crank pins shall not exceed ¼ in.

(*e*) Oil and grease cups shall be securely attached to rods, and grease cup plugs shall be equipped with suitable fastenings.

(*f*) *Locomotives Used in Road Service*—The bore of main rod bearings shall not exceed pin diameters more than 3-32 in. at front or back end. The total lost motion at both ends shall not exceed 5-32 in.

(*g*) The bore of side rod bearings shall not exceed pin diameters more than 5-32 in. on main pin, nor more than 3-16 in. on other pins.

(*h*) *Locomotives Used in Yard Service*—The bore of main rod bearings shall not exceed pin diameters more than ⅛ in. at front end, or 5-32 in. at back end.

(*i*) The bore of side rod bearings shall not exceed pin diameter more than 3-16 in.

Rule 142 (*a*) *Spring Rigging*—Springs and equalizers shall be arranged to insure the proper distribution of weight to the various wheels of the locomotive, maintained approximately level, and in a safe and suitable condition for service.

(b) Springs or spring rigging with any of the following defects shall be renewed or properly repaired:

(*c*) Top leaf broken or two leaves in top half or any three leaves in spring broken. (The long side of spring to be considered the top.)

(*d*) Springs with leaves working in band.

(*e*) Broken coil springs.

(*f*) Broken driving box saddle, equalizer, hanger, bolt, or pin.

Rule 150 (*a*) *Driving and Trailing Wheel Tires*—The minimum height of flange for driving or trailing wheel tires, measured from tread, shall be one inch for locomotives used in road service, except that on locomotives where construction will not permit the full height of flange on all drivers, the minimum height of the flange on one pair of driving wheels may be ⅝ in.

(*b*) The minimum height of flange for driving wheel tires, measured from tread, shall be ⅞ in. for locomotives used in switching service.

(*c*) The maximum taper for tread of tires from throat of flange to outside of tire, for driving and trailing wheels for locomotives used in road service, shall be ¼ in., and for locomotives used in switching service, 5-16 in.

(*d*) The minimum width of tires for driving and trailing wheels of standard-gauge locomotives shall be 5½ in. for flanged tires, and 6 in. for plain tires.

(*e*) The minimum width of tires for driving and trailing wheels of narrow-gauge locomotives shall be 5 in. for flanged tires, and 5½ in. for plain tires.

(*f*) When all tires are turned or new tires applied to driving and trailing wheels, the diameter of the wheels on the same axle, or in the same driving wheel base, shall not vary more than 3-32 in. When a single tire is applied, the diameter must not vary more than 3-32 in. from that of the opposite wheel on the same axle. When a single pair of tires is applied, the diameter must be within 3-32 in. of the average diameter of the wheel in the driving wheel base to which they are applied.

(*g*) Driving and trailing wheel tires with any of the following defects shall not be continued in service:

(*h*) Slid flat spot 2½ in. or more in length; flange 15-16 in. or less in thickness, gaged at a point ⅜ in. above the tread, or having flat vertical surface 1 in. or more from tread; tread worn hollow 5-16 in. on locomotives used in road service, or ¾ in. on locomotives used in switching service; flange more than 1½ in. from tread to top of flange. (See figs. 1, 2 and 3.)

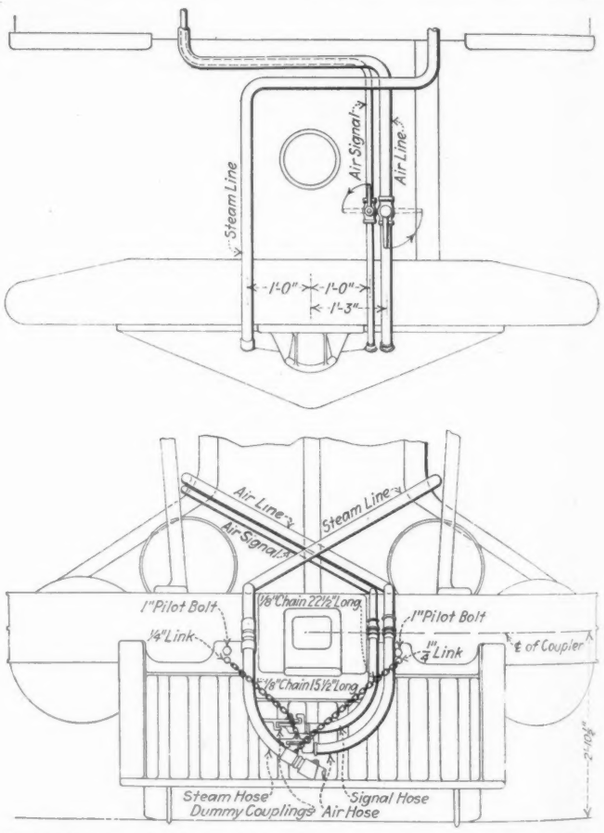
Note—The determination of flat spots and worn flanges shall be made by a gage as shown in fig. 8, and its application to defective tires, as shown in figs. 9, 10 and 11.

LOCATION OF TRAIN PIPES ON THE FRONT OF THE LOCOMOTIVE

BY H. SNECK
Supervisor of Air Brakes, Buffalo, Rochester & Pittsburgh

It is general practice to run the brake pipe and signal line on the front end of the locomotive out over the pilot beam on the right or engineman's side and the car heating steam line on the left side.

The front of a locomotive is the only piece of rolling stock that does not have the brake pipe on the right side when facing the front, according to the M. C. B. standard. Therefore, when coupling the hose on the front end of one locomotive to the rear of another locomotive or to a car both hose come together on the right side, causing the hose to buckle. This, to a great extent, reduces the opening through



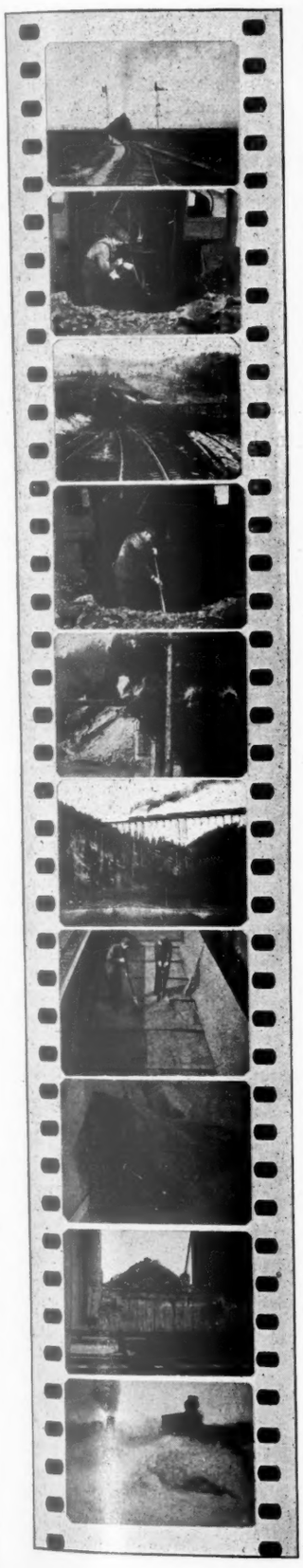
Arrangement of Train Line Pipes on the Front of Buffalo, Rochester & Pittsburgh Locomotives to Comply with M. C. B. Standard on Cars

the hose and prevents quick action from running by this point.

The new location in which the pipes are crossed is just the reverse of the old and was brought about as a remedy for the inability at times to get the emergency application of the brakes to run by the second engine in a two-engine train. It will be noted in the drawing that all the hose cross under the coupler when connected up, which prevents any possibility of buckling. The M. C. B. standard dimensions may be used for the location of each pipe.

The Buffalo, Rochester and Pittsburgh has used this method on all locomotives for more than 10 years and it has proved very satisfactory.

FUEL SAVING METHODS ON THE N. P.



Fuel Instruction Car Employs Laboratory Demonstrations and Moving Pictures, and Brings Results

BY M. A. DALY
Fuel Supervisor, Northern Pacific

THE Northern Pacific links together Wisconsin, Minnesota, North Dakota, Montana, Idaho, Washington, Oregon and Western Canada; yet, we don't feel that we are very far from the east. I suppose this is because every year we go to West Virginia and Pennsylvania to buy coal with which to supply a large percentage of our locomotives throughout the following year. Nevertheless, it is a long distance to haul coal. The average rail haul is about 200 miles from the eastern mines to the Lake Erie ports, where the coal is loaded into ships. It is a 900-mile boat haul from the Lake Erie ports to Duluth. At Duluth the coal is again loaded into cars and hauled by rail as far west as the Missouri River, a distance of 500 miles. By the time it reaches its destination the coal has become very expensive —and that is just the reason why our people have felt compelled to do everything they could to get the greatest possible amount of heat out of every ton of coal used.

The necessity developed a campaign of fuel economy, beginning about eight years ago, and we have kept right at it ever since. It has been largely an educational movement, designed to interest not only the men who handle coal, but the officers who supervise the operating performances.

FUEL INSTRUCTION CAR

To introduce the work a passenger coach was fitted up as a traveling lecture room.** Chemical and physical apparatus was installed to demonstrate the properties of coal and the chemistry of combustion. Stereopticon views and motion pictures were added from time to time, as needed.

In passing over the line, at suitable intervals, the instruction car was located at places convenient for the men at the various division points. Locomotive and power-plant engineers and firemen, interested roundhousemen, despatchers, yardmasters, superintendents, trainmasters, master mechanics, road foremen and other local officers presented themselves for the various lectures. The responsibilities of individuals were reviewed, proper methods of handling coal were emphasized and fascinating possibilities were pointed out.

With all who are directly or indirectly concerned with fuel the plan has been to realize a common understanding of its great value, develop an appreciation of the actual losses in known wasteful practices, and to anticipate the enormous savings to be accomplished by concerted efforts, systematically and persistently applied.

It was made clear from the start that fuel saving was a non-departmental matter, that instead of being the work of one department it was a matter of interest for all departments. And it was easily shown that there was enough available glory to be obtained so that all departments could take some of the credit.

Beginning with the preparation of coal at the mines attention is given to all phases of distribution, consumption and accounting. But, since approximately 95 per cent of all railroad fuel is consumed on locomotives, it naturally follows that special attention is given to its use on locomotives. Just as some engines through improper condition may burn more coal than others (of the same class), so, some enginemen through improper operation may burn more than other

*Abstract of an address before the New York Railroad Club, April 18, 1919.

**A description of the car and an outline of the lectures which are given was published in the *Railway Age Gazette* of May 1, 1914, page 976.

enginemen, and some firemen through improper handling may burn more than other firemen.

According to observations on various railroads, one fireman may burn as much as three tons per trip more than other firemen in the same service, using the same engine, on a similar train, over the same piece of track, under identical conditions. Now, men in general take a natural pride in doing good work. Once show a man that he can give better service with less labor and you have confronted him with a double argument which is seldom wholly lost. Once convince a fireman that when coal is properly placed in the firebox it will make more steam and less clinkers, that the required steam pressure will be more uniform and more certain, that the trip will require less shoveling and less shaking, and you have a fireman who is on his way to open-minded appreciation of instructions.

About all that is required for good firing is a little care and attention, with proper intention. Any instructed fireman can supply the necessary care and attention, and become a good fireman.

TALKS IN INSTRUCTION CAR

Of the lectures in the instruction car, perhaps the thing that most impressed our enginemen and firemen were the chemical experiments illustrating how combustion may take place. In one instance, a wide mouthed bottle was inverted over a lighted candle to prove that when the contained oxygen was consumed burning stopped. Hydrogen was prepared. With a proper supply of oxygen a lighted match could explode it. With no oxygen present, this highly inflammable gas would extinguish a lighted match. Thus, after a series of similar experiments, it was conclusively shown that to have burning, oxygen must touch the fuel. Accordingly, it became clear to enginemen and firemen why it was necessary to have a draft bringing air through the grates into the firebox, and why air must constantly supply new oxygen to the pieces of coal throughout the burning firebed.

Considering then that since oxygen of the air is necessary for burning, and, since air cannot well pass through clinkers or banks in a firebed, it follows that clinkers and banks are not desirable things to have in a firebox. Following this line of thought, it is but a step to consider that while gas is being driven from each piece of coal that lies in the firebox, this gas cannot be burned unless oxygen comes in contact with it. It then becomes obvious that the best firebox condition is possible only when air is coming through every square foot of grate surface.

In one of the demonstrations a pound of coal is put into a retort, heat is applied and the gases driven off. The coke remaining is weighed and computations made on a blackboard, bringing out the fact that approximately one-half of the heat value of coal is in the gas. The gases themselves, having been collected in transparent jars, are then burned in various ways to illustrate proper and improper combustion. They can be burned with a clear, white flame, giving off intense heat, or may be burned with a dull, yellow, smoky flame, developing very little heat. One smoky flame and one white flame are placed under separate test tubes containing equal amounts of water. The white flame evaporated completely the water above it, using much less gas than the smoky flame. We had the smoky flame when the supply of oxygen was not sufficient to burn the flow of gas; that is, the smoky, imperfect, low-heat, extravagant combustion took place when the supply of gas was greater than could be burned by the available oxygen.

Here again was a direct comparison with the locomotive firebed. A fire that is fed, at short intervals, with small quantities of coal, properly scattered over the surface of the firebed, will give a dazzling white fire to be compared with the dull red fire that comes when a large quantity of coal is thrown in at one time. To the enginemen and firemen this latter "slugging" method begins to take on a new aspect; the greater the quantity of coal thrown in at one time the greater the quantity of gas which may be rapidly driven off. And of course, when the quantity of gas exceeds the proportionate flow of oxygen through the grates, the excess gas cannot be burned and will pass off as smoke, through the stack—wasted. Then they correctly conclude that since 50 per cent of the heat value of the coal is in the gas, their aim must be to burn as much of the gas as possible, and thus they are intellectually persuaded to lean toward light and frequent firing, which is clearly the more economical method, and at the same time much the easier.

Firemen were encouraged to experiment for themselves, and it was not long before enginemen and firemen were boasting of the fact that they were making trips on one or more tons of coal less than formerly.

Competition is encouraged by comparing different crews on similar runs, between certain points. Road foremen use tally counters to ascertain the number of scoops, while a pocket scales will tell the weight of an average scoop, allowing the determination of the approximate number of pounds of coal used on the trip.

This all becomes very interesting when facing the fact that our Mikado locomotives often leave terminals with $125 worth of coal on their tenders, and each locomotive may take on an additional $50 or $60 worth of coal at some intermediate coal dock.

Our strong point with firemen has been that the more care exercised in placing the coal in a firebox the less coal will be required on the trip. This fact was taught not only verbally but by actual demonstration. So successfully has the plan worked out that we have men who actually fire our heaviest Mikados with one scoop to a fire. Now, single scoop firing is very particular work. Every fireman has not the patience to work it out, to master it. We do not advocate it, but we do point it out as an ideal to which firemen may aspire. Those who can approach it use less coal than formerly. Those who can master it use the least coal with the least labor. We do not ask our firemen to fire to a diagram.

THE MOVIES

The value of self-criticism has not been overlooked as a means of aiding enginemen and firemen to raise the character of their service. By the use of motion pictures they have been enabled to see themselves as others see them. The result has been very gratifying.

(Mr. Daly then showed several hundred feet of motion picture films which demonstrated in a most forceful way the advantages and disadvantages of proper and improper firing and the losses due to wastefulness and carelessness. For instance, with the moving picture camera mounted on the tender, pictures were shown of firing by the single scoop method as compared to the ordinary methods. Not only did the pictures clearly show the movements of the fireman but at intervals the camera was elevated so that a view was obtained over the top of the cab showing the results at the stack. Pictures were also taken from the roadside showing the trains in motion and the effect of the proper and improper methods of firing as reflected in the amount of smoke from the stack.

Moving pictures were also shown of the wastefulness of overloading tender tanks, of carelessness in unloading and cleaning out coal cars, and of the losses due to popping. In order to maintain interest on the part of the men, particularly during the period of the war, pictures were interposed showing the great need for fuel conservation in order to reduce to a minimum the number of cars required. Such pictures, for instance, might show the results of the freight congestion at the eastern seaboard, or the great trains of troops and munitions which it was necessary to transport, etc.

Typical individual pictures selected from the films are shown in the photographs, but, of course, they give no adequate idea of the forceful way in which poor or indifferent methods of firing can be contrasted by means of the movies.

RESULTS

Mr. Daly did not include in his paper any figures as to results secured on the Northern Pacific, but during the discussion he was questioned as to this and as to the size of the locomotives on the Northern Pacific. His reply showed that the average tractive power of the freight locomotives in service was high. He was also able to furnish the following figures as to fuel consumption which are taken from reports recently issued by the Fuel Conservation Section of the United States Railroad Administration:

FREIGHT SERVICE

	Pounds of coal per locomotive mile		Pounds of coal per 1,000 gross ton mile	
	December, 1918	January, '19	December, '18	January, '19
N. P.	241	237	162	175
G. N.	279	277	213	221
C. B. & Q.	304	294	223	221
C. & N. W.	275	285	226	242
U. P.	310	291	235	226
C. R. I. & P.	244	255	247	256
M. P.	217	240	176	200
Erie	307	299	206	210
Southern	282	312	281	320
A. T. & S. F.	262	265	209	216
C. M. & St. P.	273	251	212	219

EDITOR.)

DISCUSSION BY GEORGE M. BASFORD

Let's get our heads out of the sand. Our nation must get out of the wasteful class. It must get over thinking that its resources are limitless. It must conserve many things, first of all coal. Coal comes in train loads. There are other train loads waiting to be moved and all hands on a railroad naturally feel that anything so easy to get is somewhat like dirt and therefore is cheap.

With wages up, probably to stay, and with coal costs doubled, the locomotive must be looked at in a new light. The present generation is to be held accountable for its stewardship. In a large sense it is to be tried on the charge of wasting coal.

Let us acknowledge and appreciate everything that the government and the railroads are doing to improve the firing of coal and the management of the coal itself. Great improvements are being made in this direction. However, we must not overlook the fact that the best of coal and the best management of the fire may be nullified by the locomotive itself if the machine is not what it ought to be. This is being overlooked today in the case of thousands of old engines.

What is wanted is to put the locomotive in shape for its various parts to pull together to use the coal to best advantage. Boilers should not send wet steam to the cylinders. Fireboxes should not send unmixed and therefore unburned gases to the flues. Tender tanks should not send water to the boiler unheated by waste heat. There are a lot of other ways in which many old engines are working against themselves for lack of modern means for conserving their faculties and abilities. Even the best of firing of itself cannot insure the proper development of the heat of the coal or its use in producing power. The engine must have the means properly to make and use the power that is in the coal.

How about the 25,000 locomotives that as to power remain as they were built and are ten or more years old? Unless these engines are brought up to date they are antiquated, obsolete and an encumbrance as to power and as to the waste of fuel. Many of these engines were ten or more years old when they were built. This was because of bridge or other weight limitations. Today they are in the class of the old Rodman cast iron cannon, whereas we have Hindenburg lines to deal with today.

Think for a moment of the taking of the Hindenburg line. No small factor in the achievement was the confidence the men had in their equipment. They knew that this country had not sent them out without the best of everything to fight with. The inspiration of this confidence was necessary to success. Now think of the men who are handling these old engines we are talking about. What coal saving effort can you expect of men who know that the machine you give them wastes coal faster than they can save it?

In six years the coal consumption of locomotives has gone down from 3.6 lb. per draw bar horsepower to 2.25 lb., the figures being taken at the most efficient power of the engine. No parallel improvement has ever been made in six years in any other branch of engineering development.

This has been done by intelligent use of improved designs and by the employment of labor and fuel saving and capacity increasing factors which everybody knows about. These figures show what may be done and what is in everybody's mind to aim at with new engines, but why overlook the 25,000 old ones?

The fortunate feature of these improvements lies in the fact that they may be applied to all old engines that are in shape to run at all and they give these old engines increased power, making them, weight for weight, equal to the biggest, newest engines of the latest and best designs, and in many instances they will be better adapted for the work they are doing than new engines would be.

I mean that one big thing to do right now is to modernize those old engines—25,000 of them, applying to them the factors that make the modern locomotive take its place among the efficient power plants of the world. The way to do it is to make a survey of the old equipment in complete detail, to decide upon a modernizing program and determine the number of engines to be rejuvenated per month and then follow the program in spite of "hell and high water."

One of the roads that did this found that the improvements paid for themselves in seven months. Every $100 of cost earned $171.60 in the first year. This was 171 per cent investment. If the engines had but one year of life ahead of them it would have paid most handsomely. Did it pay? Is this one of the big economies? Does it not put in the shade all other locomotive economies that you can think of?

The steam locomotive of America is too big a factor in the success, stability and happiness of the nation to allow so large a proportion of antiquated equipment to be running hauling tons and hauling people at the high cost that these conditions entail. These old engines ought to be modernized or they ought to be scrapped, and that quickly.

The survey of the power on any railroad will reveal the merits of this question. It is my opinion that this survey is one of the most important immediate problems before the railroads. The best thing about it is that it can be done now, and that it will point out the best business policy of the roads—no matter who owns them.

A small engine need not be an uneconomical engine just because it is small. You need lots of small engines and always will need them. They should be put into the efficient class and their lives prolonged. By the way, this policy will overcome the extravagance of the past in the purchase of new power, much of which was necessary merely because there was so much unmodernized power on the road.

Some of you are thinking—"That's all right, but where is the money?" Let me tell you where the money is. It is blowing up the stack of every unmodernized engine. The entire first cost of modernizing is wasted in coal every seven to ten months on every one of these engines that is working. That's where the money is.

Did we back away from Germany because we didn't have the money for the war? We got the money!

You will find it easier to convince the hard-headed businessmen, the shippers, that you ought to have freight rate

increases—after you have modernized these old engines. The shippers understand modernizing. That's why they succeed in business. That's why they have something to ship.

If you have had the inspiration of watching rival gun crews handling modern guns, you will appreciate the fact that, to do the work of today, which is greater work than that of yesterday, the guns must be *right*. It is not sufficient that the handling only should be right. The results are up to the right guns handled *right*. The more worthy the gun the better it will be served and the more it will do. This is exactly true of the locomotive. Every scoop of coal well fired does the more work when the engine is modernized. Modernizing augments every other means of saving. Let's get our heads out of the sand.

OTHER DISCUSSION

H. C. Woodbridge, fuel supervisor, Allegheny region, spoke particularly of the part transportation officers have in the conservation of fuel, mentioning a number of things not generally done now which they could do to reduce fuel consumption. When business is heavy it is now a common practice to start trains out from terminals whenever enough cars are available to make up a train, without regard to conditions at either the despatching or receiving terminals. He advocated the despatching of trains according to a predetermined plan, based on a careful study of the expected amount of business for any particular season, in which consideration has been given to conditions at terminals and important intermediate points on the division. In this way temporary congestion at terminal yards and engine terminals may be avoided and the power received only as fast as it can be handled. Such a plan has a marked influence on coal consumption through the elimination of delays en route and at the terminal.

The maximum allowable tonnage should be maintained, and tonnage should be reduced promptly to meet extraordinary conditions of weather, partial engine failures, etc. Tonnage trains should be given assistance out of the initial terminal to prevent delays in movement during the time in which the train is getting warmed up. Through loads should be segregated and pick-up work confined to certain trains rather than being handled hap-hazard by every train over the division. Train despatchers and tower men should be made to see clearly the effect on fuel consumption of slowing or stopping tonnage trains. Recommendations from trainmen as to the revision of schedules should be carefully considered; engines should be assigned and not pooled; the road foremen's time should not be taken up in conducting efficiency tests, etc., but devoted to supervising the operation of the locomotives on the road; the use of unnecessary lighting should be discouraged, and men should be disciplined for pulling apart air hose and allowing locomotives to waste steam at the pops. A close check should be kept on slow orders to eliminate their use or continuance except within absolutely necessary limits. The most efficient engines should be used and the inefficient ones scrapped or stored as opportunity permits.

Robert Collett, fuel supervisor of the Eastern region, laid stress upon the fact that nothing saves so much coal as an all-around good job of railroad operation. Any practice or plan which tends to improve general operating conditions is bound to reduce the consumption of fuel. Mr. Collett said that his conception of the function of the Fuel Conservation Section lay more in passing on the good things already being done from one road to another, than in initiating absolutely new practices. In dealing with the use of coal on the locomotive he suggested that more stress be placed on telling the men about their good performances than in continually criticising them for their failures. The business of a ralroad is to move trains and enginemen should not be critisised if they place more stress on keeping engines hot than upon the question of fuel economy, unless they have been thoroughly instructed in the best methods of firing and operating locomotives. As an evidence of the effect of operating conditions on fuel economy, he mentioned the fact that a 40 per cent difference in fuel used on the same passenger train on two succeeding days had been observed, where the principal difference in conditions lay in the necessity for stopping at block signals in one case, whereas a good run was made in the other.

Mr. Collett quoted from a comparative statement recently issued by the Fuel Conservation Section, which shows that the best results in reduction of fuel consumption on a gross ton-mile and passenger car mile basis have been obtained in the Central District of the Eastern region. Comparing the last six months of 1918 with the last six months of 1917, thus eliminating the effect of the extraordinary weather conditions prevailing during the early months of 1918, the average reduction in freight unit consumption for this district was 9.2 per cent and in passenger train-unit consumption 7.1 per cent. As shown by the available statistics, the total reduction in all regions was 5.5 per cent in freight service and 3.2 per cent in passenger service.

H. B. Brown, superintendent fuel department, Lehigh Valley, referred to the fact that, next to labor, fuel is the largest single item in railroad operating expenses and that the coal bill of the railroads was $150,000,000 greater in 1918 than in 1917, a fact which necessitates the redoubling of efforts to conserve coal from the standpoint of economy. He also referred to the necessity of fuel economy from the standpoint of the conservation of a natural resource which is not inexhaustible.

George L. Fowler called attention to the effect of proper firing methods on boiler repairs, stating that the opening and closing of the fire door produces a change in temperature of the firebox sheets reaching a maximum of 100 deg. F. in some parts of the firebox.

W. E. Symons referred to economies which could be effected in the 15 per cent of railroad fuel not burned in locomotives. By converting coal into producer gas for stationary power plant purposes, as high as $1.80 per ton may be realized from the sulphate ammonia, which is a by-product of the gas producer process.

Photograph by International Film Service Company, Inc., N. Y.

Belgian Workmen Beginning Reconstruction of the Railway Station at Ghent

THE RESISTANCE OF MATERIALS

The Effect of Sudden or Abrupt Changes in Section on the Distribution of the Unit Stress

BY G. S. CHILES AND R. G. KELLEY

III

FIGS 14a and 14b illustrate the unstrained and strained conditions of a strip of rubber perforated with a square hole as shown at *c*, Fig. 1, and in contact with glass plates as heretofore described. The pull which was exerted in this case was, as in the previous instances, five pounds. The stress action which is in evidence in this instance is somewhat similar to that which occurred in the case of the round hole with the exception that the maximum strain or deformation is found to take place at the corners of the hole. As in

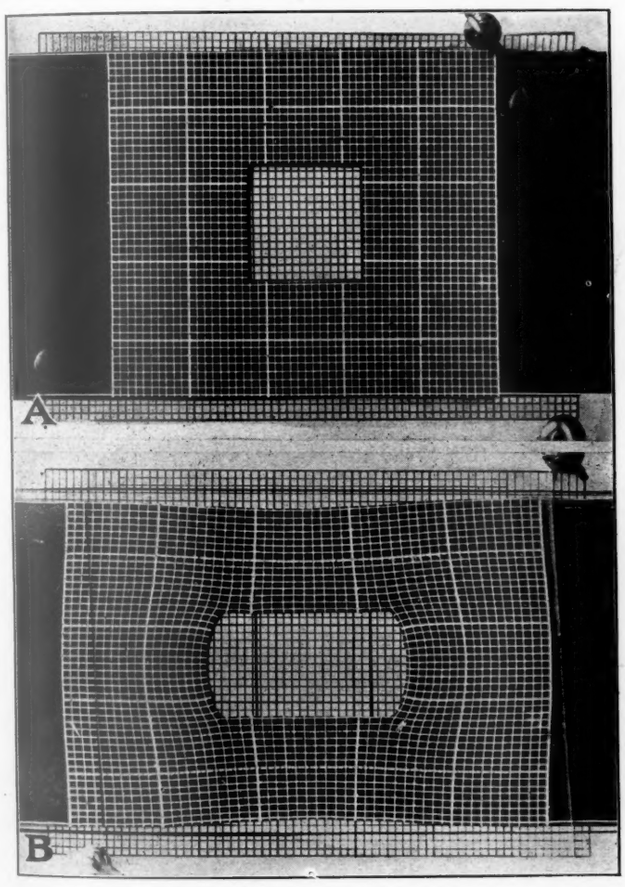


Fig. 14—Effect of a Square Hole on the Distribution of Stresses in a Rubber Sheet Under Tension

the case of the rounded openings, the compression at the upper and lower edges is again quite pronounced.

Table II summarizes briefly the data relative to the various rubber strips mentioned above.

TABLE II—DIMENSIONS, LOADS AND CALCULATED FIBER STRESSES OF SHEET RUBBER TEST SPECIMENS*

Line	Hole, 1½ in. diameter or square	Boss	Net sectional area, sq. in.	Total load, lb.	Calculated fiber stress lb. per sq. in.
1	Without	Without	0.1665	5	30
2	With	Without	0.111	5	45
3	Without	Without	0.1665	7	42
4	With	With	0.1830	7	38.2

*Specimens were 4½ in. wide by .037 in. thick; bosses were 3 in. in diameter and .048 in. thick.

Fig. 15 represents an eye bar designed in accordance with the standard practice of the American Bridge Company which calls for a maximum and minimum allowable thickness of one inch and one-half inch respectively.

Fig. 16*a* is a photographic reproduction of a model of the eye bar shown in Fig. 15 cut from rubber and having all of its dimensions exactly one-half of those of the standard eye bar of minimum thickness. The model was ruled up, as indicated in the photograph, in an unstrained condition

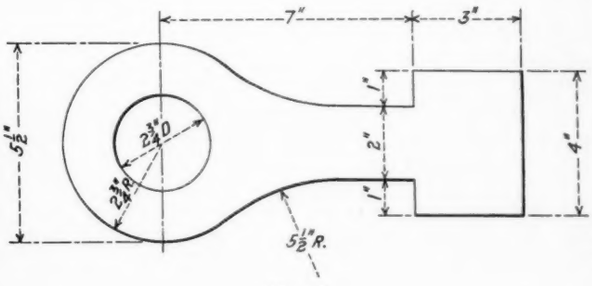


Fig. 15

with white ink lines spaced equally, ten to the inch, as heretofore described.

The lower end of the eye bar, the part having a width of four inches, was fastened to a soft pine board by means of a thin wooden strip as shown in Fig. 16*a*. The wood disk represents an eye bar pin. By exerting pressure on this disk the rubber was strained as shown in Fig. 16*b* and the

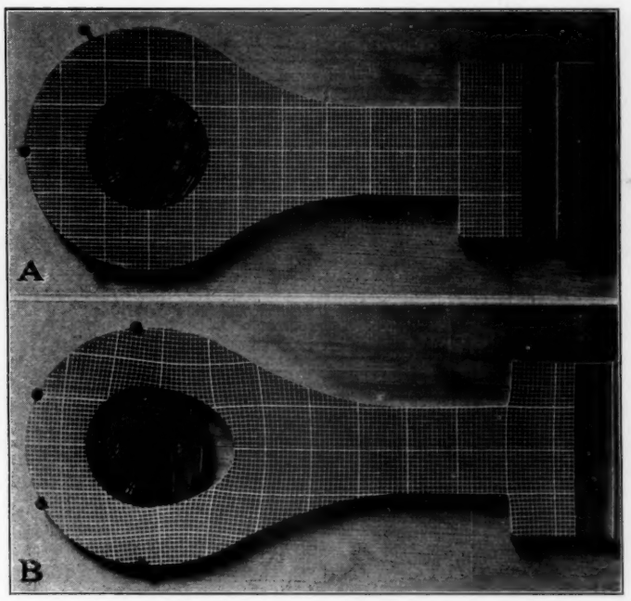
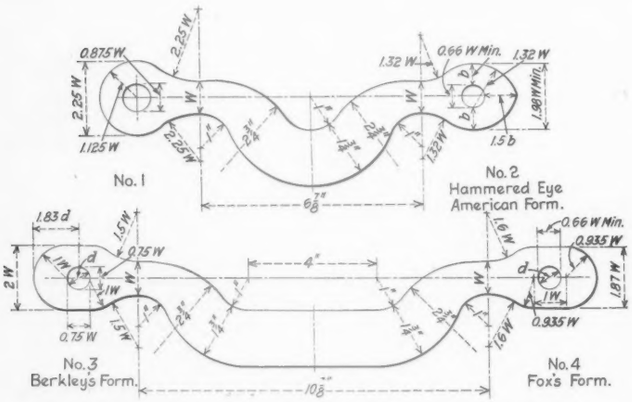


Fig. 16—Stresses Around the Pin in an Eye Bar

disk was then fastened with four small brads. It was found necessary to use tacks in order to keep the cutter rim of the circular end of the eye bar from buckling. The load was not measured in this experiment. The resulting deformation and stress distribution are plainly evident in the photograph and it will be noted that the stress action in the piece under strain in this photograph is quite similar to that illustrated

in Fig. 12*c*, the similarity being quite marked along the edge of the hole which has been pulled away from the pin, and to a lesser degree along the edge in contact with the pin. The compression is again very noticeable at the lower edge of the hole. The lower white ink line, some ¾ in. above the upper edge of the wood strips, is not horizontal or parallel to the strip but is curved slightly near its center, a condition which becomes more pronounced near the offset portion. If



Note: Forms and proportions of eyes (in terms of W) No. 1 – American Bridge Co. standard (2 inch width, 1¾ inch maximum pin diameter) reduced one-half. Numbers 2, 3 and 4 see Machine Design, Construction and Drawing, by Spooner.

Fig. 17

a triangle is placed over Fig. 16*b* to coincide with the top four-inch line at the outer edges, this line, which was originally straight on the unstrained rubber, will be over 0.1 inch above the edge of the triangle near the vertical center line of the test piece. It is evident by comparing the horizontal lines near the projecting parts that these projections break up the uniform stress distribution so apparent an inch or so above.

Fig. 17 represents two different designs of offset tie bars each of which is provided with ends of different style. As stated in the legend beneath the drawings, the left end of the upper tie bar, marked No. 1, is designed in accordance with the American Bridge Company's standard practice, while the right end, No. 2, and ends No. 3 and No. 4 of the lower tie bar are designs abstracted from Spooner's "Machine Design, Drawing and Construction." It will be ob-

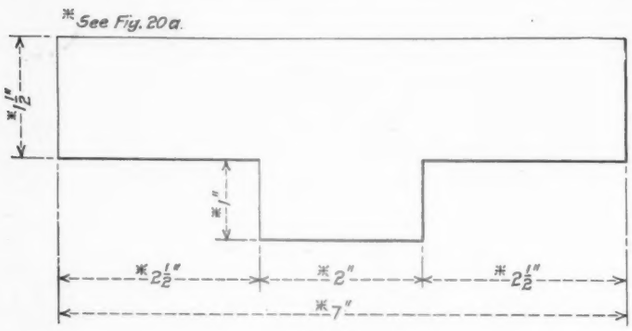


Fig. 18

served that the mid-section of the lower bar has a straight length of four inches and consequently is four inches longer than the mid-section of the upper bar, but that otherwise they have the same general dimensions up to the points where they meet the radii from the eye ends. The mid-section of the upper tie bar is a curved member, the inner and outer radius being purposely drawn from the same position. To this design a straight section was added, thus forming the lower design for the purpose of investigating the effect which this straight portion would have upon the deformation when the tie bars were subjected to the same load. The four designs of ends were used merely as a matter of interest and comparison, as it was considered that the difference in design would have no influence upon the stress action in the mid-section of the bars.

Fig. 19*a* represents models of the tie bars cut to the dimensions shown on the drawings from rubber one-fourth-inch thick and ruled up, in an unstrained condition, with white lines spaced as previously described. For convenience in drawing comparisons between the unstrained and strained condition of the bars, the pine board upon which they were mounted was also ruled with corresponding lines, and the outline of the bars in their unstrained state drawn in. These

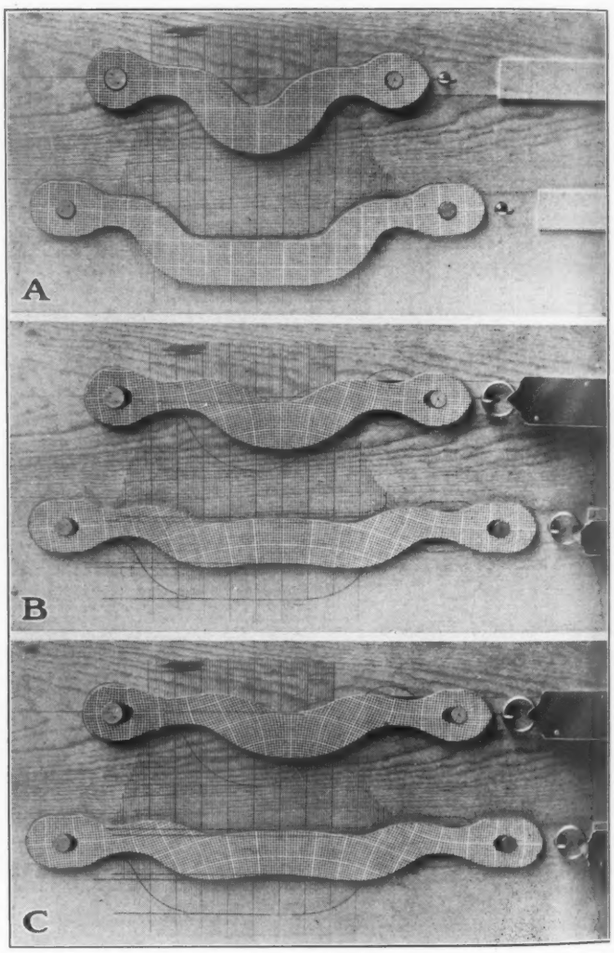


Fig. 19

pencil lines were drawn with the model in a horizontal (flat) position while the photographs were taken with it in a vertical (upright) position, as was true in all the experiments, and the weight of the test pieces together with slight pin clearances, accounts for the slight discrepancy between the actual and drawn contour of the eye bars in Fig. 19*a*. As in the case of Fig. 16*b* wooden disks were inserted in the eye ends to represent eye bar pins. In this experiment, however, the wooden disks on the right were fastened to a movable section of the stationary board.

Each of these tie bar models was subjected to two pulling loads of four pounds and seven pounds respectively and photographed in its distorted position under these loads as shown in Figs. 19*b* and 19*c*. From the reference lines on

the board, it will be observed that the lower edge of the mid-section of the short bar is in compression and that the stress action, both as regards tension and compression, is more intense in the short bar than in the long bar.

The lower edge of the long bar for both loads measured very nearly the same as in the unstrained state showing that the tension due to the axial load is just sufficient to overcome or neutralize the compression due to the eccentricity of the load. There is very little tension along the upper edge of the neck of the short bar and practically no stress at the corresponding sections of the long bar. The most severe tension in the body of the short bar is along the curved part of the upper edge and a fairly high tension along the lower edge of the neck portions. In the long bar the most severe tension is in the curved parts on the upper

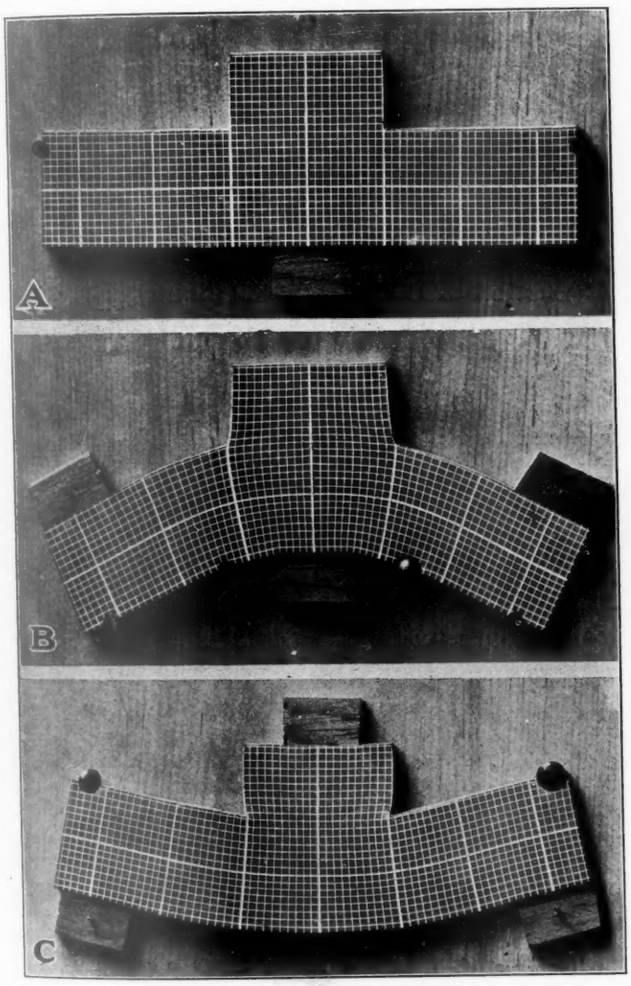


Fig. 20—The Effect of a Projecting Lug on Local Stresses in Rubber Specimen Subjected to Bending Loads

edge adjoining the straight portion. The tension along the lower edge of the neck of the long bar is greater than it is along the originally straight upper edge of the mid-section. The large deformation in these rubber tie-rods equalizes stress distribution to some extent.

In Fig. 19*b* it will be observed that, whereas Figs. 17 and 19*a* show one inch between the upper edge of the rubber models and a line joining the center of the pin centers, or an eccentricity of 1⅞ in., the upper edge of the short tie bar is approximately on the pin center line, equivalent to an eccentricity of ⅞ in., while the upper edge of the rubber at the center line of the long bar is 0.4 in. above a line joining the pin centers, an eccentricity slightly less than ½ in. With the greater load of Fig. 19*c* the rubber tie bars show a still greater deformation.

In order to investigate the effect upon the stress distribution in sections of irregular shape when subjected to a bending load, the irregular shaped section shown in Fig. 18 was cut from a special grade of rubber ¼ in. thick and ruled up in the unstrained condition as previously described. The ruled up section is shown, mounted upon a board, in Fig. 20*a*.

For the first experiment, the load was applied to the long straight edge so as to put the material along this edge under compression and the material in the opposite or irregular edge in tension. This arrangement is illustrated in Fig. 20*b*, the tacks being placed after the load was applied to prevent the rubber from buckling. The photograph clearly indicates that practically no deformation took place along the upper edge of the one-inch by two-inch projection, whereas the stress at the corners where this projection joined the main body was unduly severe.

For the second experiment, the load was applied at the upper edge of the projection. The stress action along this edge and at the corners was somewhat similar to that obtained above and is indicated in Fig. 20*c*.

It will be noticed that on a line through the projecting part, paralleling the uniform section, in the first test the rubber is in tension, and in the second test the ruled lines show a compression, the maximum stress in each case being on a continuous line, that is, on a line common to the upper and lower rectangles, and not at the outermost edge, as might be supposed. In fact if the width of the upper two-inch edge in Fig. 20*b* is calipered and compared with the corresponding edges of Figs. 20*b* and 20*c*, it will be found that very little change in length has taken place due to bending.

No doubt the reader in reviewing the elastic action of the rubber specimens, as illustrated, will question the validity of the test results, or their inconsistency with the usual theoretical formulae. It should be remembered that the usual formulae relative to the strength of materials apply only to such members as plain bars, etc., having a uniform and continuous cross-section and not to members having an irregular contour or whose cross-section increases or decreases suddenly.

In writing this article on the effect of abrupt changes of section on the resistance of materials it has been the aim of the writers to recapitulate available data and in addition thereto, by means of the rubber test specimens, assist the designer in visualizing its practical application.

TUBE SPACING TO SUIT BAD WATER CONDITIONS

BY C. E. BROOKS
Superintendent Motive Power, Grand Trunk Pacific

One of the greatest sources of trouble to railroad men operating in bad water territory without a doubt is tube leakage. By bad water conditions is meant waters which carry from 50 to 300 grains of impurities per one-thousand U. S. gallons. A typical analysis is as follows:

	Grains per U. S. gallon
Silica	.974
Oxide of iron	.128
Carbonate of lime	Trace
Sulphate of lime	56.391
Carbonate of magnesia	19.378
Sulphate of magnesia	7.007
Sodium and pot. sulphate	26.562
Sodium and pot. chloride	1.700
	112.140

It is a well known fact that often a locomotive does fairly well as far as steaming qualities are concerned, until shopped, with flues so badly scaled and mudded up that they have little if any conductance; in fact, many cases are found where the flues are simply smoke conveyors, and take but

very little part in the action of the boiler. The remarkable feature is, that if firebox sheets are in good condition steaming qualities are much less affected than one would expect.

I believe this can be attributed almost entirely to the present systems of tube spacing, which I consider have these two general defects:

(1)—Impeding the circulation of water about the flues by forcing the globules of steam formed on the flues to work through a zig-zag course, thereby

(a)—delaying steam generation, and

(b)—forming a much greater insulating coat of steam over the tubes, resulting in loss of heating surface.

(2)—Facilitating the blocking up with scale due to the impossibility of loosened scale or mud working its way through to the belly of the boiler, the general result being blocking up of water spaces with mud and impeding circulation thereby.

The remedy for this appears to be: First, the use of a much larger diameter flue than present practice calls for below the superheater flues; second, spacing these tubes in vertical and horizontal rows, with the maximum reasonable spacing; third, eliminating all small tubes between the superheater flues.

The object of the use of larger tubes is to reduce the resistance of the gases and, combined with the vertical and horizontal spacing, to give the generated steam globules the shortest and easiest path to the surface of the water and permit loosened scale to drop to the belly of the boiler.

No doubt these recommendations will meet with criticisms from many sources, the chief of which will be loss of heating surface and poor staying of sheets. The answers to these objections are that the heating surface is of little value if not covered with water, and that in order to get a maximum so-called tube heating surface important principles of conductance and circulation have been sacrificed by designing the tube spacing to effect a maximum resistance to both.

As far as staying is concerned, it should be recalled that in bad water districts where a set of tubes, properly applied, may leak the first trip over the road, 90 per cent of the leakage occurs in a part of the sheet which is well stayed, namely, towards the center of the small tube area. This is due, not to the fact that too much stress is exerted on the bead of the flue, because in that case we would get the same results with good water. It is due to the fact that when certain combinations of impurities exist in the boiler steam pockets are formed where the circulation is poor, thereby resulting in overheating the beads, with the resultant expansion and contraction, which finally causes a leak. The only real remedy for this is circulation, which can be improved by a re-design of the vertical passages between the tubes.

RAILROAD ADMINISTRATION NEWS

Status of Shop Crafts; Wage Case; Summary of Fuel Conservation Results; Report of Safety Section

PRACTICALLY all of the locomotives that have been used during the past year on railroads other than those of their owners, in accordance with the Railroad Administration's plan of pooling facilities, are now being returned to their home roads or are in repair shops on their way home. Instructions were issued about March 1 that when leased locomotives could be returned to their owning roads without inconvenience and without serious interruption to traffic it should be done, as a large number of the roads at that time had locomotives of their own in storage. Nearly 800 locomotives at that time were being operated under lease by roads other than their owners. They have been repaired and put in good shape before returning at the shops where the work could be most conveniently done. In many cases, particularly where locomotives were returned from eastern or southern roads to the western lines, it was necessary to use very roundabout routes because of insufficient clearance.

STATUS OF SHOP CRAFT WAGE CASE

In reply to many inquiries from its members "relative to the delay in the settlement of wage increases" asked of the director general by the shop craft organizations on January 7, the Railway Employees' Department of the American Federation of Labor has explained that after having presented its arguments to the wage board on March 12, 13 and 14, its committee was notified that the representatives of the regional directors were not prepared to present their side of the matter, and the hearing was postponed by the board till April 14. The employees committee protested vigorously against this delay, but the board declined to alter its decision. This case is being presented by 14 representatives of the employees, with B. M. Jewell, acting president of the Railway Employees' Department, as chairman, and 14 representatives of the regional directors, with C. E. Chambers, mechanical assistant to the regional director for the Allegheny region, as chairman.

On April 15 Mr. Chambers testified before the Board of Wages and Working Conditions at Washington, and asked the board to deny the increases in wages and allowances asked by the federated shop crafts affiliated with the American Federation of Labor, on the ground that their wages are now higher than those paid generally by industrial concerns not under government control. The rates asked by the shop crafts include a basic rate of 85 cents an hour for experienced mechanics in place of the present rate of 68 cents, 60 cents for helpers, and also differentials for certain classes of employees, 30 days' holiday a year and other concessions in time. These increases, Mr. Chambers said, amount to 25 per cent in the basic rate, 46 per cent for second class electrical workers now paid 58 cents, 35 per cent for car men now paid 63 cents and 46 per cent for those now paid 58 cents.

He presented a set of exhibits comparing the rates of wages paid to railroad shop crafts with minimum, maximum, going and average hourly rates paid to employees performing similar work in 1,293 industrial plants. Ship yards and similar plants were not included, he said, because of the emergency character of the work. The information was received in reply to questionnaires, all of which have not yet been answered, so that the information is not entirely complete. The exhibits showed average hourly rates in the outside industries as follows: Machinists, 56.2 cents; boilermakers, 62.6 cents; blacksmiths, 58.4 cents; sheet metal workers, 54.7 cents; first class electrical workers, 55.8 cents; second class electrical workers, 46.3 cents; car men, 48.2 cents; molders, 60.6 cents, and helpers, 44.3 cents. The majority of the outside machinists receive rates of 50 cents and upward, while the prevailing rate for helpers is 45 cents. Mr. Chambers said that the pay rolls had also been increased by the classification of work made in Supplement No. 4 to General Order No. 27, because the first class rates are now paid in many instances for work formerly performed by helpers at a lower rate, as

the craftsman rate is now paid for some of the work performed by men not fully qualified as craftsmen. Formerly a craftsman engaged in piece work made his helper do all he could, whereas now in the intervals between work assigned to the helpers, the helper frequently does nothing. Mr. Chambers also presented exhibits showing the labor turnover, which he said now is about 50 per cent less than it was during the first half of 1918; in other words, it has been reduced to about normal.

A. O. Wharton, vice-chairman of the board, questioned the completeness of the figures because they did not include many industries on the Pacific Coast where high rates have been established, or in the inter-mountain territory, where he said he knew that many mechanics were receiving a minimum of $1 an hour. He also commented on the absence of figures from the Ford Motor Company, which he said had recently established a minimum of $6 a day for mechanics. Mr. Chambers said that many of the questionnaires from the more remote points had not yet been received, and that the committee had been unable to obtain the figures from the Ford plant. He remarked that the $6 minimum was 75 cents an hour.

BACK PAY FOR SHORT LINE EMPLOYEES

Director General Hines has recently announced a decision that employees of the short line railroads which were not taken under federal control because of the general counsel of the Railroad Administration ruled that they were not "systems of transportation," are not entitled to back pay under General Order No. 27, and that employees of railroads relinquished and subsequently taken under federal control are not entitled to back pay for the period back of the date of the contracts subsequently executed. As to the employees who might have been induced to subscribe for Liberty bonds by the appeal sent to all railroad men early last year by Director General McAdoo, calling attention to the fact that they were about to receive increases in wages and back pay, Mr. Hines says that unfortunately these assurances were not restricted, as they ought to have been, to employees of railroads operated by the government, but that there was no intent to mislead any employees, and that those who bought Liberty bonds on the strength of such assurances have only done what every class of citizenship was urged to do; and have made a splendid investment unless they have lost because it became necessary to sell the bonds at a discount.

These conclusions, adhering to the position formerly taken by Mr. McAdoo, were expressed by Mr. Hines in a letter to the chief executives of the organizations representing railway employees, who had asked for back pay for the short line employees back to January 1, 1918.

ECONOMY IN CONSUMPTION OF COAL IN 1918

Good results attained in 1918 as a result of the campaign for fuel economy are shown in a compilation prepared by the Fuel Conservation Section of the Railroad Administration comparing some of the principal statistics relating to the consumption of coal for 1916, 1917 and 1918. The tons of coal consumed in freight service in 1918 amounted to 86,634,345 as compared with 79,454,966 in 1916 and 86,795,339 in 1917, but the pounds of coal per 1,000 gross ton miles show a decrease in 1918 as compared with 1917, although an increase compared with 1916. The amount was 199.7 in 1918, 200.9 in 1917 and 192.1 in 1916. In passenger service the tons of coal consumed in 1918 amounted to 30,570,030 as compared with 32,583,171 in 1817 and 30,494,233 in 1916. The pounds of coal per passenger train car mile used in 1918 averaged 19.3 as compared with 19.4 in 1917 and 18.5 in 1916. In the last six months of 1918 the pounds of coal per 1,000 gross ton miles were only 190.7 as compared with 201.8 in 1917, a decrease of 5.5 per cent, and the pounds per passenger car mile were 18.2 as compared with 18.8, a decrease of 3.2 per cent.

The report also compares the average cost of coal per ton in December, 1918, and December, 1917. The figures for some of the principal roads, which do not include the cost of the haul on the user's rails, are as follows:

Road	December, 1918	December, 1917
New York, New Haven & Hartford	5.78	5.25
Delaware & Hudson	3.99	3.61
Boston & Maine	6.21	5.44
Erie	3.49	3.77
Lehigh Valley	3.62	3.06
Michigan Central	3.78	3.63
New York Central	3.43	3.07
Baltimore & Ohio—Eastern Lines	2.56	2.30
Baltimore & Ohio—Western Lines	2.65	2.30
Pennsylvania Eastern Lines	2.88	2.48
Pennsylvania Western Lines	2.76	2.48
Philadelphia & Reading	3.75	3.51
Atlantic Coast Line	4.25	4.00
Louisville & Nashville	3.13	2.15
Southern	3.48	2.68
Chicago & North Western	3.01	2.19
Chicago, Milwaukee & St. Paul	3.42	2.87
Atchison, Topeka & Santa Fe	3.53	2.97
Southern Pacific	6.02	6.72
Union Pacific	2.77	2.48
Missouri Pacific	3.09	2.51
St. Louis-San Francisco	3.32	2.69

ARRANGEMENTS FOR EQUIPMENT FINANCING

Arrangements have been completed for temporarily financing the amounts now due the car and locomotive builders by the Railroad Administration, amounting to approximately $40,000,000, by the issuance of certificates of indebtedness, bearing interest at five per cent, which may be used as collateral for loans from the banks or possibly from the War Finance Corporation, but up to April 9 the certificates had not actually been issued. Some of the certificates, which are to be in convenient denominations for that purpose, will be passed by the equipment companies to the sub-contractors who furnished materials and specialties, but whose contracts are with the builders rather than with the government. For this reason the specialty people were not admitted to the conferences between the builders and the Railroad Administration representatives, but conferences between the sub-contractors and builders were held afterward. Some of the specialty men were inclined to insist on being paid in cash rather than certificates, but it is stated that if they insist on cash they will have to wait until it is available, as the companies to whom the certificates are issued will have to give their own notes to the banks and might thus be left "holding the bag" for a time in case of unexpected delay to the railroad appropriation.

Whatever interest above five per cent is charged by the banks will be reimbursed by the government.

A sub-committee was appointed to represent the equipment companies at Washington in connection with the issuance of the certificates, consisting of George Shaw, Standard Steel Car Company; H. W. Wolf, American Car & Foundry Company; L. O. Cameron, Pressed Steel Car Company, and F. O. Riener, Haskell & Barker Car Company. Companies having contracts with the builders were requested to telegraph their bills as of April 1 to J. M. Hansen, secretary of the car and locomotive manufacturing committee, at Washington.

REPORT OF SAFETY SECTION

The Railroad Administration has issued a notice regarding a report of the Safety Section, stating that since the government took control of the transportation facilities its record is one of which both employers and employees should have cause to feel proud. The statement indicates, however, that a similar pride is not felt in the activities of the railroad safety departments before that time. On January 1, 1919, there were 20,156 railroad men serving on railroad safety committees under the direct supervision of the Safety Section "actively working for safety on the railroads; whereas a year ago there were comparatively few men thus employed." It

is also stated that on certain typical roads, where, in the month of January, 1918, there were in the aggregate 212 persons killed, and 3,118 were injured, the record for the same month in 1919 shows the number killed as 94, and of injured 363. Apparently it is not the province of the Safety Section to note any difference in operating conditions in the two months.

Concerning the campaign directed to cleaning up yards and rights of way, one of the big roads reports:

"One division has picked up between 675 and 700 carloads of scrap and debris; and 92 cars of scrap iron were gathered along rights of way in yards. On the divisions that were cleaned up through the efforts of the safety department a number of old link and pin couplers were picked up, a proof that no clean up had been made for a number of years." One of the circulars issued by the brotherhood lodges reads: "We feel the safety movement is of the utmost importance to all employees and your hearty co-operation and earnest support is requested, that accidents and personal injuries to our fellow employees may be reduced to the lowest minimum." The Safety Section is planning a "No Accident Month" for May in the Southwestern Region.

CONTINGENT FEE COVENANT MODIFIED

Director General Hines has announced that, with the approval of Attorney General A. Mitchell Palmer, he has consented to a modification of the covenant inserted in purchase contracts under the direction of the Department of Justice issued June 18, 1918, prohibiting the payment to agents of fees contingent upon the procuring of contracts with the government in so far as it relates to railroad contracts.

Since this order was promulgated by the attorney general, there has been a good deal of complaint from railway supply houses that its provisions were working a hardship upon them, and that the government itself was losing the benefits of a system which, previously, had proved both economical and satisfactory in every particular.

Hereafter, the attorney general's order will not affect contracts made between the Railroad Administration and supply houses which, previous to government control, carried on their business through bona fide selling agencies.

At the suggestion of John Barton Payne, general counsel for the Railroad Administration, the following clause will be inserted in appropriate cases in future railroad contracts:

"Provided, however, that this covenant shall not invalidate a contract obtained through a bona fide commercial representative employed under a general contract covering designated territory and shall not prohibit or penalize the employment of the same agencies, rates and methods of compensation in dealing with the United States heretofore customarily employed by the contractor in the regular course of his business in similar dealings with the railroad corporations."

ORDERS OF THE REGIONAL DIRECTORS

Payment of Employees on Hourly Basis Instead of Piece Work Basis.—The Southern regional director has issued the following:

"Referring to my telegram E-64, January 2, 1919, repeating message from the director general of railroads, dated Washington, December 31, regarding preference of shopmen throughout the country to be paid on hourly basis, as provided in Supplement No. 4 to General Order No. 27, rather than the piece work basis in effect on many railroads.

"Acting under the permission of the director general, granted by his message December 31, 1918, employees on many railroads have indicated their preference with respect to working upon an hourly instead of a piece work basis. Director Tyler, Division of Operation, Washington, writes me he is advised that at some shops, after a decision has been reached in this way, certain local officers or foremen are continuing to agitate the matter, urging upon the men that another vote be taken, with the result that in some cases two or three votes have already been taken upon the subject.

"This is taken as indicating a purpose on the part of those local officers to circumvent the wishes of the director general, so clearly expressed in his telegram of December 31. The effect is to keep the shop organizations at such points continually agitated with most certain detrimental effect upon the efficiency and morale of the organization.

"Will you please direct that on railroads under your jurisdiction where employees have once decided this matter by vote, it will be considered as definitely settled during the period of federal control."

Repairs of Short Line Cars.—The regional director, Eastern region, by circular 500-14-5A669, announces that beginning with April 1 bills for repairs to cars and engines belonging to non-federal roads—the "short lines"—are to be made on the basis of actual cost of labor and materials, plus 15 per cent, with 10 per cent added to the total to cover superintendence and accounting. Material furnished by the road owning the car or locomotive is to be billed to the road making the repairs, which, in turn, should re-bill it at the same rate plus 15 per cent for handling. Proper credit is to be allowed for scrap at current prices.

Reclamation of Scrap.—The regional director, Eastern region, by circular 2900-99A-670 calls attention to carelessness in the gathering and sale of scrap material. Scrap material has been sold without assortment, and new articles, available for immediate use, have been sold as scrap. Federal managers are called upon to review the instructions and regulations now existing in order to make sure that the greatest possible care is exercised, and to take any action that may be found necessary to insure that the sorting, reclamation and sale of the scrap is being properly and economically handled.

Use of Lock Nuts and Grip Unit Nuts on Boilers.—Order 186 of the Southwestern regional director calls attention to the fact that lock nuts and grip unit nuts are being used on studs which are screwed into boilers, and instructs that hereafter lock nuts and grip unit nuts must not be used in this manner, and that where a lock nut is required a jam nut is to be used.

Brakes on U. S. R. A. Hopper and Gondola Cars.—Order 194 of the Southwestern regional director requires inspectors to make a special inspection of all United States composite gondola standard and hopper cars, and that where these cars are found without sheave wheels on the brake shaft end of the hand brake rod to send these cars to shop, regardless of ownership, and have the brake arrangement changed to conform to the approved standard.

Use of Headlight Generators.—Circular 203 of the Southwestern regional director reminds enginemen that by keeping water gages and shields clean or by slightly relocating the lamps of these water gages, it will not be necessary to run headlight generators during daylight as is now being done in many cases.

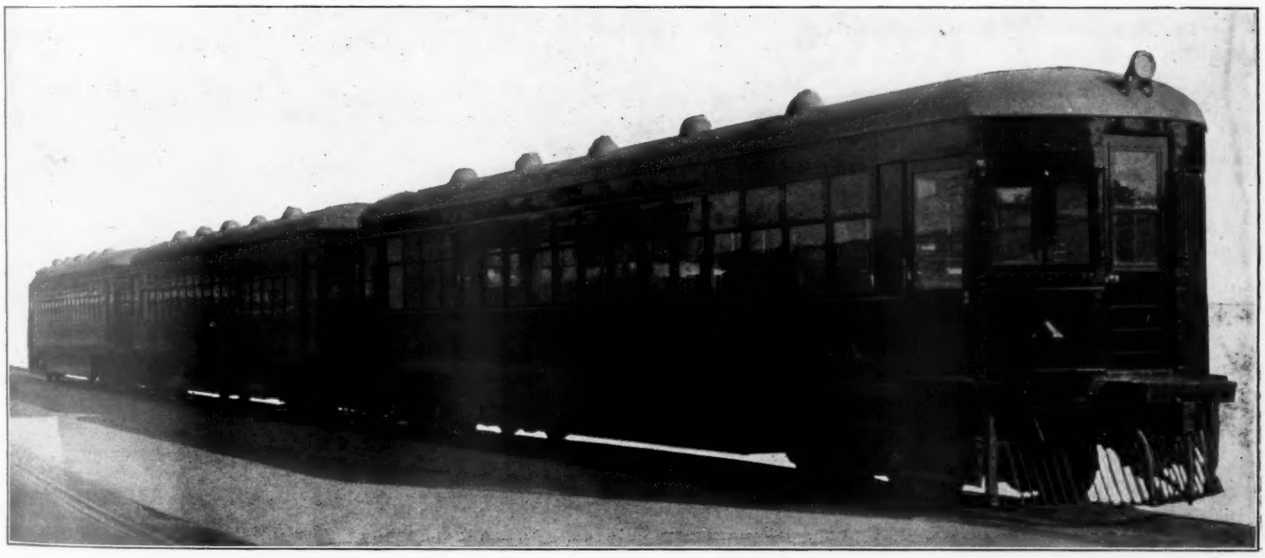
Reports of Air Brakes Cleaned.—The Eastern regional director by Order 1801-131A691, calls for regular monthly reports, beginning with April, showing the number of freight car air brakes overhauled, with a statement showing the ratio of number cleaned to number of freight cars owned.

IRON THAT CAN BE WHITTLED.—It is well known that rapid cooling of hot metals hardens them. That the opposite is true has recently been demonstrated in striking fashion by the General Electric Company. One of their scientists annealed American ingot iron surrounded by hydrogen gas for three hours at a temperature above 1,600 deg. F. The product was very little harder than the softest copper, and can be whittled with a knife.

STORAGE BATTERY CARS FOR USE IN YUCATAN

The three cars shown in the illustrations have just been delivered to the United Railways of Yucatan by the Railway Storage Battery Car Company, New York. The cars are driven by motors geared to the axles and power is supplied to the motors by Edison storage batteries. The cars are designed to be operated either singly or in trains by multiple unit control.

The schedule as laid out for service to be performed covers the run from Merida to Progreso, a distance of 23.6 miles.



Three Storage Battery Cars Recently Shipped to the United Railways of Yucatan

There are six stops between terminals and the running time over the line is 45 minutes. The city of Merida has a population of 70,000, while that of Progreso is 8,000. The grade between the two cities is practically level and the total service per day is three round trips. The cars are fitted for passenger service and are able to draw a trailer carrying baggage and express matter.

CONSTRUCTION

The car is constructed according to M. C. B. standards and the car body and its appliances are all steel with the exception of doors and inside fittings. The over-all length of car body is 56 ft., the extreme width is 8 ft. 6 in., and the extreme height is 12 ft. Reversible seats upholstered with rattan are used and the seating capacity of the car is 66 persons.

The underframe is built up of two 6-in., 10.5 lb. channel center sills spaced 13¼ in. back to back, with side and end sills of 10-in., 15-lb. channel sections. The transoms are built up of flat plate; the top or tension member is 9 in. wide by 7 in. in thickness, while the bottom member is 9 in. wide by 1 in. in thickness. In addition to the end sills the underframe includes a curved buffer beam of 5-in. by 5-in. by ½-in. angle section curved to a radius of 18 ft. ¾ in. The cross members of the underframe are 6-in., 8-lb. channels and are five in number.

The body frame is of light steel construction, the posts being 2-in. by 2-in. by ¼-in. T-sections, sheathed below the windows with 3/32-in. steel plate. The side plates are 2½-in. by 2½-in. by ¼-in. angles. The carlines are of sections similar to the posts and they extend across the car from side plate to side plate.

The cars are fitted with M. C. B. couplers and single spring draft gears.

Brill 69E trucks are used. These trucks have a 5-ft. 6-in. wheel base and are spaced 14 ft. between centers. They are of the arch bar type, are light, each weighing 6,220 lb. without motors, and are fitted with M. C. B. wheels and axles. Roller bearing journal boxes are used.

The total weight of car without load is 56,600 lb.; the batteries alone weigh 12,600 lb., and the total weight of the motors and control equipment is about 6,000 lb. This makes a total weight per passenger, on the basis of the seating capacity, of about 500 lb.

MOTOR AND CONTROL EQUIPMENT

Each car is equipped with four General Electric, No. 261, 250-volt, direct current motors. There is one motor for each

axle and each motor is connected to the axle with a single reduction gear. These motors were supplied to meet the requirements of supplying a single car with 88 mechanical horse-power during acceleration and 28 mechanical horse-power when running free and to supply a car and trailer with 166 mechanical horse-power during acceleration and with 39 mechanical horse-power when running free. The motors are protected by Condit instantaneous, automatic, overload circuit breakers.

The electrical equipment includes double end multiple unit control and the cars are connected with a seven-point cable when they are used in multiple units. The cars are equipped with General Electric straight and automatic air brakes.

BATTERY

Each car is equipped with a battery of 248 Edison type A-12 cells; 240 of these cells are used for the power circuit and eight for the lighting circuit. While the battery is being charged all of the cells are connected in series. A Sangamo ampere hour meter is installed in the charging circuit to insure the batteries the proper amount of charge and to protect them from overcharge.

PERFORMANCE

These cars are capable of developing a speed of 45 miles an hour on level tangent track. It is possible for them to negotiate grades of from 8 to 10 per cent and to haul loads of from 30 to 35 tons at a fair maximum speed. They may also be used to spot and drill loads up to 150 tons. Under ordinary service conditions their range of operation on one charge of the battery is about 120 miles, although this range will seldom be required in branch line service.

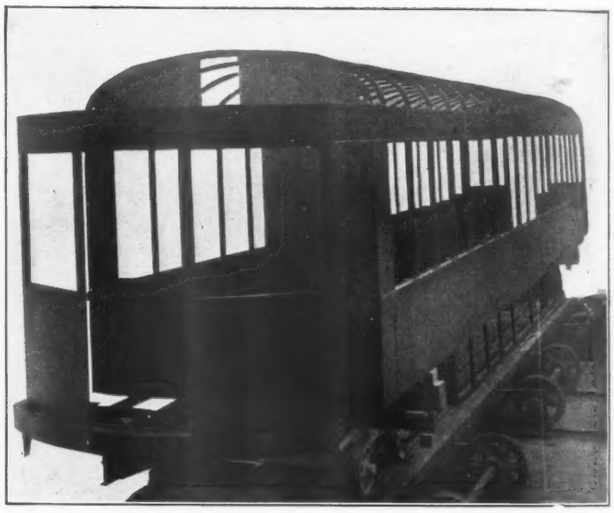
The particular advantage of this type of car as presented by the maker lies principally in the characteristic of the alkaline storage battery. As the battery is comparatively light in weight, the total weight of the car is not excessive and as the battery is strongly built and not affected by ordinary vibration and shock it lends itself particularly to this class of service. The only attention required for this class of storage battery is to keep it charged and filled with water.

Interior of the Storage Battery Car for Yucatan Showing the Seating Arrangement

For branch line steam railroad service cars of this type have the advantage of requiring little attention which cannot be given by the regular passenger car maintenance forces. Aside from the batteries the only other special equipment are the motors and control apparatus, which need little attention except at general overhaul periods.

A storage battery, of course, represents a loss of efficiency, but it does away with line losses, as compared with a trolley system, and where 24-hour service is not required the cost of keeping power on the line with no cars running is eliminated. Furthermore, it is usually possible to charge batteries during an off-peak period and thereby obtain a lower charging rate.

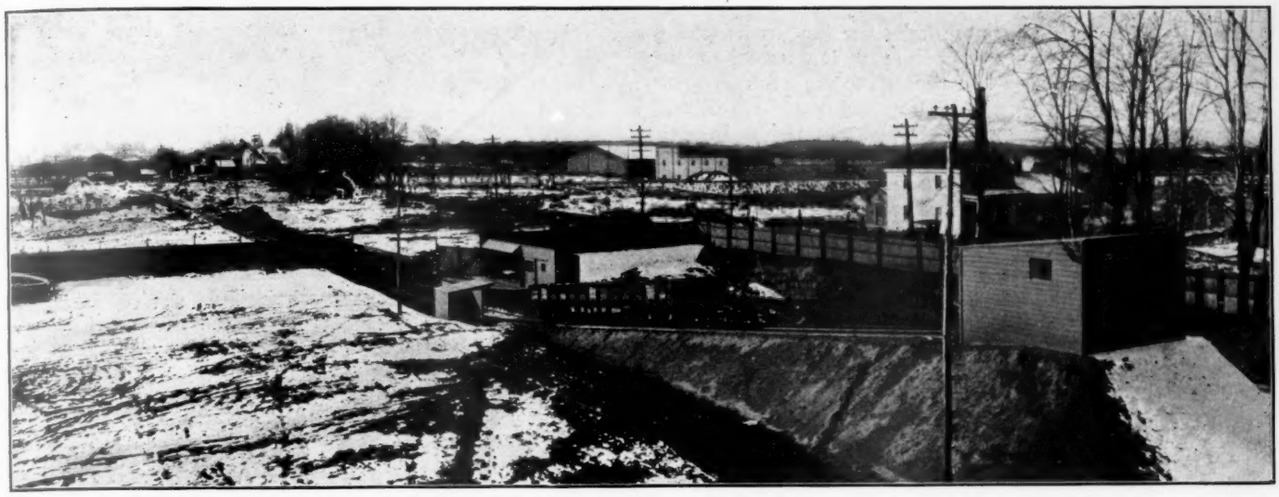
Similar cars are in use on the Cambria & Indiana, the Lorain, Ashland & Southern, the Atlanta, Birmingham & Atlantic, the Chattahoochee Valley, the Long Island and the Pennsylvania. During the mechanical conventions to be held at Atlantic City next June a demonstration car of this type will be in operation between Atlantic City and Ocean City.



The Car Bodies and Their Appliances Are All Steel, Except for the Doors and Inside Finish

STANDARD FREIGHT CARS ARE HELD IN STORAGE

Since the signing of the armistice, in addition to the large number of idle cars which have been in service, several thousand of the new standard cars built on the orders placed by the Railroad Administration last year have been completed by the builders, but cannot be stencilled because the railroad companies, which are expected to take them and pay for them, have not yet accepted them. Over 26,000 of the 100,000 standard cars ordered had been accepted by the roads to March 31, according to a statement compiled by the Railroad Administration, but this does not account for at least 10,000 more than have been built, and are being held in storage until it can be ascertained whether the Railroad Administration can force the companies to take them at the high prices. The administration takes the position that it can, because they were ordered under war conditions and allocated to the various roads, but many of the companies are not in a position to finance them, and meanwhile the Railroad Administration is paying for them at the contract price minus an amount to cover the cost of stenciling. The standard locomotives, on the other hand, are being accepted as fast as they are turned out.



Draft Gear Test Plant of the T. H. Symington Company

DRAFT GEAR TEST DEMONSTRATIONS

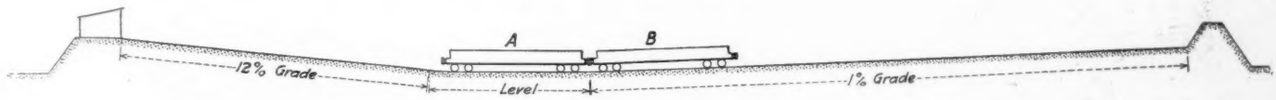
Method of Recording Action Under Impact Between Cars Devised by Inspection and Test Section

ON April 10 and 11 a series of public demonstrations were conducted by the Inspection and Test Section of the Division of Operation, United States Railroad Administration, at the draft gear testing plant of the T. H. Symington Company, Rochester, N. Y. The manufacturers of draft gears, the draft gear committee of the mechanical section of the American Railroad Association, the mechanical committee of the Railroad Administration and a number of railroad officers were present. The purpose of the demonstration was to disclose in advance of a series of official draft gear tests to be conducted at this plant, the methods of testing which will be followed, and particularly to demonstrate the operation of the devices which have been developed to graphically record the action of the draft gear between two cars, one moving and the other standing at the instant of impact.

For a period of several months the Inspection and Test Section has been engaged in testing draft gears under the direction of B. W. Kadel, assistant engineer, the program including tests both with the static machine and under the drop, and the work to be performed on the Symington plant constitutes the next series of tests in the draft gear program, in all of which the draft gear committee of the Master Car Builders' Association is co-operating.

The test plant of the T. H. Symington Company was built to facilitate the testing of draft gears under as nearly as possible actual service conditions. It consists of a test track, one end of which is laid out on a 12 per cent grade for accelerating purposes, followed by a section of level track at the other end of which is a one per cent ascending grade. Two 50-ton steel frame gondola cars with wood floors and siding are used in the tests. The facilities for handling the cars consist of a motor driven drum hoist housed at the top of the 12 per cent grade, the cable from which is attached to a special puller car to which the test car is attached in such a way that the coupling may be tripped at any predetermined point on the grade; a motor driven capstan winch beside the track is used to spot the cars on the level track.

Both of the 50-ton gondola cars are loaded so that each has a gross weight of 143,000 lb. The adjoining ends are arranged so that they may be equipped with any draft gear of standard dimensions, or with solid buffers. The moving car, designated as the *A* car, is drawn up the inclined track and released at stations predetermined to produce whatever velocity of impact is desired. The stationary car, designated as the *B* car, is placed at a fixed point on the track so that the performance of the cars during the period of impact is comparable for all tests. This position is chosen so that the *B* car stands fully on the 1 per cent decelerating grade when struck by the *A* car, while the latter moves upon level track during the period of impact and for a distance of approximately six feet before the instant at which the buffing faces of the two drawheads come in contact. The cars are equipped with flat face buffing stems instead of standard couplers in order to produce a normal impact without coupling the cars.



Profile of the Test Track

The method of recording and comparing the action of various draft gears under impact between the two cars is a development recently worked out by the Inspection and Test Section and the engineers of the T. H. Symington Company, working together.

The outstanding feature of the new recording apparatus is that a direct and continuous record is made of the movement of both cars during a period beginning before the

instant of impact and continuing after the final separation of the two cars. The records of the car movements are made by pencils traveling in a line parallel to the track and marking upon revolving drums, one for each car, both of which are mounted on a common shaft also parallel to the track. The drum shaft is worm driven by a 32-volt shunt-wound, direct-current motor, which receives its power from a storage battery. The paper speed of the drum is approximately 31 in. per second. The pencil holders for the two drums are mounted on guides parallel to the axis of the drums and are moved by bars which project out from the sides of the cars. Provision is made for horizontal movement of these bars at right angles to the longitudinal center line of the car. Guides attached to the instrument base engage a lever suitably attached to each bar to withdraw it from contact with the pencil holder before it can be moved beyond either end of the cylinder.

The line drawn upon the first or *A* drum shows the exact velocity of the *A* car at the moment of impact, denotes the exact point of impact, shows by the type of curve drawn the rate of retardation of this car and finally gives the velocity of the car after the two cars have parted. The line drawn upon the *B* drum shows the rate of acceleration of the *B* car and shows the final velocity of this car as the two cars part. Curves made in the same test upon the *A* and *B* drums are reproduced in Figs. 1 and 2, respectively.

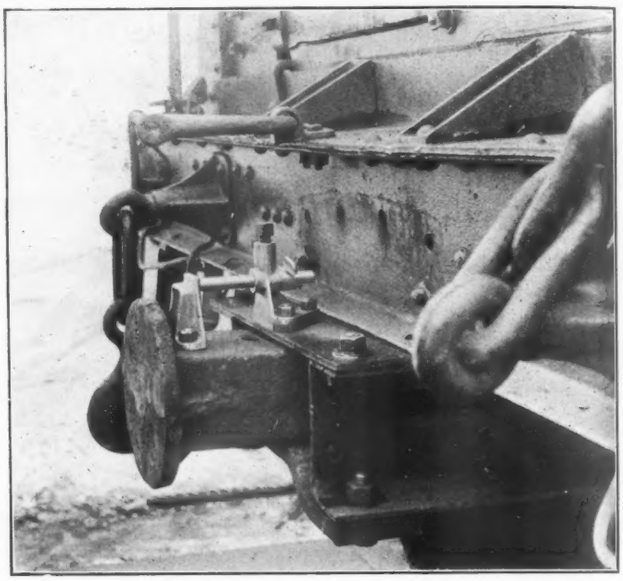
When a test is to be made the two cars are spotted with the buffing faces in contact and all slack eliminated from draft gears and attachments. With the drums standing, the pencil carriages are given a slight movement along the guides to draw common reference lines, 3-3, Fig. 1, and 4-4, Fig. 2, by means of which the two cards later may be synchronized as to time. The pencils are then set on both drums in the positions which they will occupy against the bars projecting out from the sides of the cars at the instant the buffing faces between the two cars come in contact.

With the pencil carriers thus located the drums are rotated to draw the common datum line, 1-1, Fig. 1, and 2-2, Fig. 2, upon these drums. Line 2-2 on the *B* drum indicates the standing position of the *B* car; line 1-1 on the *A* drum indicates the position of the *A* car at the first instant of contact with the *B* car. By means of these datum lines the cards for the two cars can be matched as to their positions along the track.

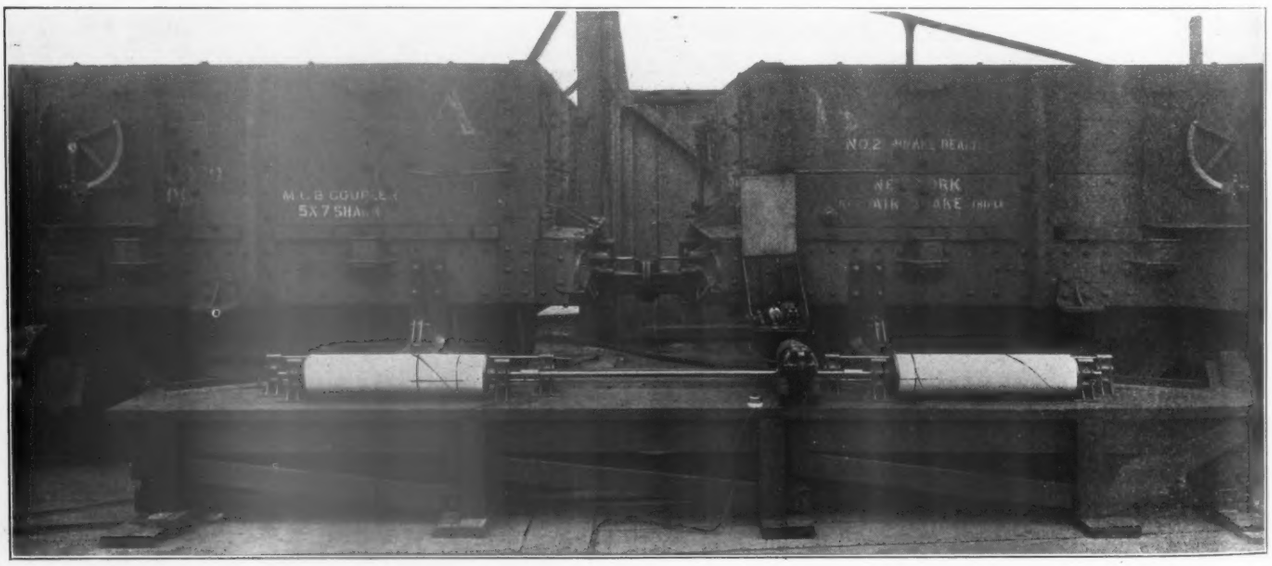
The test is then run by hauling the *A* car up the 12 per cent grade, releasing it at the point required to produce the desired velocity of impact, the pencil on the *A* drum being moved back from its impact position so that a record of the velocity of the car as it approaches the point of impact may be obtained.

From the curves a study can be made of the car movements throughout the cycle of draft gear movement and the velocity of the *A* car at the moment of impact can be accurately determined, as well as the velocities of both cars beyond the point of separation. Thus on the card for the *A* car, Fig. 1, the angularity of the line below the datum line denotes the exact velocity of the striking car, and the weight being known, its energy as a moving body can be accurately determined.

Referring again to Fig. 1, at point 5 it is known that the *A* car first met the *B* car, that the draft gears started to close



The Flat Face Buffer and Travel Gage



The Instrument on Which the Car Movements are Recorded on a Time-Distance Basis

and consequently that its velocity began to decrease. Assuming that the draft gear action is entirely smooth and that the bombardments of static testing are not present in this service, it is possible to determine from the shape of the

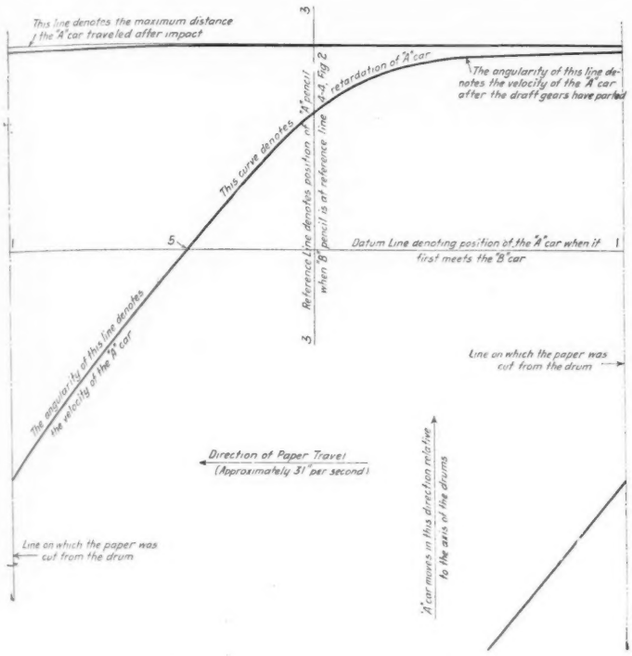

This line denotes the maximum distance of the "A" car traveled after impact
The angularity of this line denotes the velocity of the "A" car after the draft gears have parted
This curve denotes retardation of "A" car
Reference Line denotes position of "B" pencil when "A" pencil is at reference line 3-3, Fig 2
This curve denotes position of "A" pencil
Datum Line denoting position of the "A" car when it first meets the "B" car
The angularity of this line denotes the velocity of the "A" car
Line on which the paper was cut from the drum
Direction of Paper Travel (Approximately 31" per second)
"A" car moves in this direction relative to the axis of the drums
Line on which the paper was cut from the drum

Fig. 1—Card Made by the A Car

curved line denoting the decrease in velocity of this car, the approximate forces which must have been at work to produce the retardation shown between any two points on the time

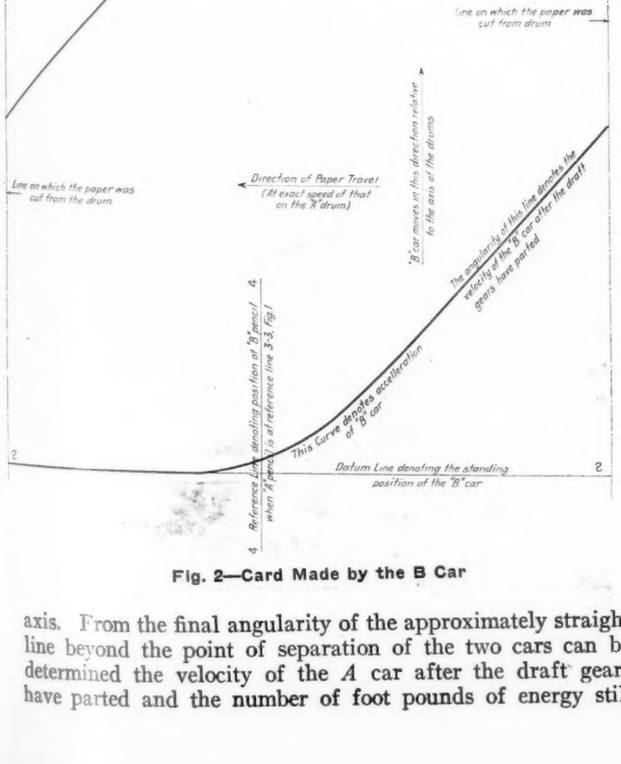

Line on which the paper was cut from drum
Line on which the paper was cut from the drum
Direction of Paper Travel (At exact speed of that on the "A" drum)
"B" car moves in this direction relative to the axis of the drums
The angularity of this line denotes the velocity of the "B" car after the draft gears have parted
This curve denotes acceleration of "B" car
Reference Line denoting position of "B" pencil when "A" pencil is at reference line 3-3, Fig 1
Datum Line denoting the standing position of the "B" car

Fig. 2—Card Made by the B Car

axis. From the final angularity of the approximately straight line beyond the point of separation of the two cars can be determined the velocity of the *A* car after the draft gears have parted and the number of foot pounds of energy still stored in this car. On cards made from certain draft gears the *A* car comes to rest as denoted in Fig. 1 before it has traveled beyond the limit of the pencil movement along the *A* drum.

Referring to Fig. 2, from the curve drawn by the *B* car can be determined the rate of acceleration of this car and its final velocity when the cars part. Knowing this velocity and the weight of the car it is possible to calculate the energy transferred from the *A* car to the *B* car. From Figs. 1 and 2 it is thus possible to determine the actual energy absorption which has taken place during the draft-gear cycle.

The common datum and reference lines drawn on the two cards prior to the test run make it possible exactly to superimpose one curve upon the other, thus producing a graphic record of the relationship of the cars to each other throughout the significant range of movement. This has been done in Fig. 3.

From the superimposed cards it is possible to determine point 5 at which the draft gears begin to close, the point at which they closed to the maximum amount, point 6 at which they finally part, the distance the cars move along the track during any period of time within the range of the diagram, the time required for any phase of the gear movement cycle, and the amount of draft gear travel at any instant, this being

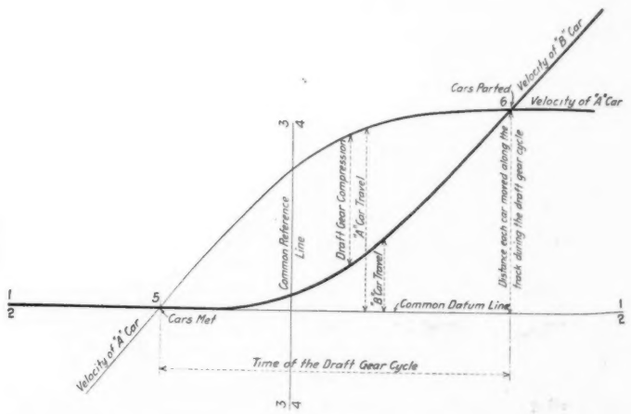

Cars Parted, Velocity of "B" Car
Velocity of "A" Car
Common Reference Line
Draft Gear Compression
"A" Car Travel
"B" Car Travel
Distance each car moved along the track during the draft gear cycle
Common Datum Line
Cars Met
Velocity of "A" Car
Time of the Draft Gear Cycle

Fig. 3—Cards from A and B Cars Superimposed

indicated by the vertical distance between the two curves at that instant.

In addition to the instrument with which these diagrams are obtained, the *B* car is also equipped with a small constant-speed motor driven recording drum, the pencil movement of which records the movement of the buffer stem on that car with relation to the car body, by means of an equalized piano wire connection to the top and bottom of the rear end of the front follower. The card from this drum reflects the smoothness of action of the draft gear in closure and release on a time-closure basis and provides a measure of the maximum closure of the draft gear on the *B* car. In addition to the record thus obtained, which compensates for any tendency of the follower to tilt in a vertical plane, the buffers of both cars are fitted with the closure gage shown in one of the illustrations, from which the maximum gear movement may be measured. These gages are a part of the regular equipment of the test cars as they have previously been used.

To the side of each car are also attached two pendulum shift gages or seismographs. The pendulums of these instruments are arranged to swing freely in but one direction from the perpendicular, the two instruments on the same car being arranged so that the pendulums swing in the opposite directions. The swing of the pendulums under the action of inertia carries with it a small marker mounted on a graduated

segment, a friction spring in the marker causing it to remain in the position to which it is moved by the swing of the pendulum. These instruments are a part of the regular test equipment of the cars and the records obtained from them provide a means of comparison of the load shifting tendencies of the impact with various draft gears.

The demonstrations were entirely unofficial in character, no records or detail comparisons of commercial gears being taken. The curves here reproduced were obtained with M.C.B. spring draft gears in both cars.

A SUPPLY TRUCK FOR EMERGENCY REPAIRS

BY A. J. KIPP
Shop Engineer, Chicago, Milwaukee, & St. Paul

A station supply truck fitted with all the material for emergency repairs which is usually carried in supply sheds, is a new device that has proved very useful since its introduction on the Chicago, Milwaukee & St. Paul. These trucks are designed to be used at passenger terminals and are a great help in making quick repairs. Formerly if a train came in with a hot box the inspector had to go to the shed for jacks, brasses and packing, but now the truck is brought up beside the car and the man has all the tools and supplies he requires within easy reach. For other minor repairs the truck has been found equally convenient.

The truck itself is 5 ft. 2 in. long, 3 ft. 8 in. high and 14 in. wide, with three horizontal doors on each side extending the full length of the truck. The arrangement was made as compact and narrow as possible so that the truck could readily be used between two trains standing on adjacent tracks. The interior is partitioned off for holding the standard supplies carried in the truck, which are listed below.

The Supply Truck Facilitates Making Quick Repairs

2—Journal box jacks.
2—Journal box jack boards.
2—Journal box jack levers (pinch bars).
2—Packing hooks.
2—Packing irons.
1—Pail prepared packing.
1—Empty packing pail.
6—Brake shoe keys.
3—Brake shoes.
Spring cotters (various sizes).
1—Brass 5½ in. by 10 in.
1—Brass 5 in. by 9 in.
1—Brass 4¼ in. by 8 in.
2—Brake connection pins 1⅝ in.
2—Brake connection pins 1¼ in.
2—Brake connection pins 1⅜ in.
1—Knuckle pin, cotter and washer.
1—Bearing wedge 5½ in. by 10 in.
1—Bearing wedge 5 in. by 9 in.
1—Bearing wedge 4¼ in. by 8 in.
12—Standard nuts each, ⅞ in., ¾ in., ⅝ in.
12—Lock nuts each, ⅞ in., ¾ in., ⅝ in.
1—Steam and air hose wrench.
1—12-in. pipe wrench.
2—1¼-in. train pipe nipples and couplings.
3—Each, ¾-in. and 1-in. train pipe nipples and couplings.
3—Combination air and signal hose couplings.
1—Small roll ⅛-in. wire.
6—Air brake defect cards.
1—Signal hose.
3—Air hose.
3—Steam hose.
1—1¼-in. angle cock complete.
6—Steam hose gaskets.
6—Air hose gaskets.
2—Signal hose gaskets.
1—Cold chisel.
1—Hammer.
1—Small drill.
1—Bracket for blue flag marker.
1—Bracket for blue lantern.
1—Screw driver.
1—Gallon can of car oil.
6—Wooden oil box lids (various sizes).
6—Pieces of second hand carpet to use as box covers.
4—Bolts ½ in. by 6 in.—3-in. thread with nut and washer and lock nut.
12—Tee head pedestal tie strap bolts with nuts and washers.
1—Coupler tail pin complete.
1—Ohio knuckle lock complete.
1—Uncoupling lever clevis complete.
1—Brake chain clevis complete.
1—Monkey wrench.
2—White pine reservoir drain plugs.

The car foremen in charge of the stations where the trucks are used are held responsible for keeping a full stock of material in the trucks at all times. Employees of the car department are the only ones authorized to have access to them, and this only in case of actual emergency. When any material is removed it must be accounted for and replaced by the employee using it. The truck is assigned to a definite location where it will be most convenient for the men who are using it, and care is taken to see that it is kept fully supplied and secured by a standard repair track lock at all times when not actually in service. These trucks have proved a great convenience and 50 are now in use on the C. M. & St. P. system.

Photograph by Press Illustrating Service, Inc., N. Y.

Hospital Car Now Used in Evacuating Soldiers from Along the Line to the Base at Vladivostok

THE LUBRICATION OF JOURNAL BOXES*

Inspection and Care of Passenger and Freight Cars in Yards and Shops; Preparation of Packing

BY M. J. O'CONNOR
Special Inspector, New York Central

IN view of the conditions that exist on practically all the railroads in the United States at the present time, the lubrication and care of rolling stock equipment is very important. The first and most important matter in connection with this feature of equipment maintenance is standard instructions, issued in book form, covering the preparation and maintenance of journal box packing, also the equipment necessary to handle the material as well as the tools, which is a very important matter in connection with the proper method of applying packing to journal boxes.

To handle the lubrication of equipment properly and to reduce hot boxes to a minimum, the following methods should be adopted: A suitable building should be fitted up with metal tanks equipped with ¼-in. mesh screens about three inches from the bottom of the tank and 1¼-in. faucets or molasses gates for drawing off the oil. The dimensions of these tanks should be in accordance with the requirements of the yard or shop, based on the number of cars handled per day. For example, at a large yard where from eight to twelve thousand cars per day are handled, in addition to a preparation tank, additional storage tanks should be maintained, in order to allow sufficient time for packing to become properly saturated in preparation tanks.

PREPARATION OF JOURNAL BOX PACKING

The waste must be carefully pulled apart and a known weight placed in the preparation vat, adding sufficient oil to completely submerge the waste (for 50 pounds of waste this will be 60 gallons of oil). Allow the packing to stand for 48 hours; draw off the excess oil (in above case this would be 35 gallons), leaving just sufficient oil to maintain the ratio of four pints of oil to each pound of dry waste. The work should be performed in a room at a temperature of about 70 deg. As the oil continues to drain, it should be drawn off from the bottom of the vat and poured back over the top of the waste, thus having the packing always ready for service. In tanks of two or more compartments, one can be used as storage for prepared packing, while the other is being used for the saturation of fresh packing.

It has been proved from experience that the waste used in the lubrication of passenger equipment cars, which is approximately 50 per cent cotton and 50 per cent wool, machine mixed, is superior to all wool, in that the fine cotton threads prevent excessive expansion and at the same time hold the material together, thus eliminating the lint which is produced by the revolution of the journal. The use of wool waste for the lubrication of freight cars is an unnecessary expense, as it has been found that as good results are not procured as from ordinary cotton waste. Cotton waste will retain the oil nearer the surface of the packing, which greatly assists the packer in knowing that the packing contains sufficient oil, whereas with all wool waste the oil precipitates to the cellar of the journal box with the result that it requires more than normal friction to convey the oil up to the surface of the journal.

The man in charge of the oil room should be thoroughly instructed to drain off the oil that settles in the bottom of storage tanks, and to pour it back over the packing several times daily. When the oil is poured over the packing it must be equally distributed to cover the entire surface of the packing contained in the storage tank. The oil rooms should be kept clean and free from dust and other foreign matter at all times, and no dry waste or wiping towels allowed to be carelessly thrown in or mixed with the packing.

In addition to these tanks, it is necessary to have a metal container to hold rolls that have been made up of dry waste, which have later been submerged in oil. These rolls are to be used without carrying much oil, or in other words, moderately dry, in order to have them ready to apply to boxes at all times. The standard dimensions of these rolls is 2½ in. in diameter by about 11 in. in length. These rolls assist in better excluding the dirt in the back of boxes as well as holding the oil in the box.

A standard dope bucket should be used for handling prepared packing and nothing else. After a train of cars has been gone over by the yard or shop doper, all packing remaining in the bucket should be placed back in the storage tank until necessary to go over the next train of cars.

METHOD OF PACKING JOURNAL BOXES

First place the prepared roll in the mouth of the box, using care to center the roll, then it should be shoved back evenly under the journal with the packing iron so that it is in the proper position when it reaches the extreme back of the box. The packing should be picked up by hand and placed across the entire mouth of the box. This is absolutely necessary in order to keep the packing evenly distributed in the operation of placing it in the box. This method insures even distribution while being placed in the box due to feeding the packing in a continual strand under the journal (not on the sides) until the box is completely packed to the center line of the journal, straight down from the inside face of the collar. No packing should extend beyond the end of the journal. It has been proved that the elimination of the so-called front waste plug affords the inspector a better opportunity to examine the contained parts of the journal box, as well as assisting the doper to know that when packing extends beyond the journal collar, there is either surplus packing in the box or else the packing has worked outward. In either case, the remedy is immediately applied.

When wheels are applied, the journals should be thoroughly cleaned, and the bearing surface of the brasses coated with oil. No waste either dry or saturated should be used in oiling the journal bearing, to avoid any particle of waste or foreign substance remaining on the journal bearing when it is applied. Tight fitting dust guards should be applied in all cases when wheels or journal boxes are applied. Where new journal boxes or integral truck sides are applied, the interior of the boxes should be free from scale and sand or any other foreign substance.

CARE OF PACKING IN JOURNAL BOXES

All passenger equipment cars are to have the packing removed, bearings examined and the boxes repacked in accordance with the foregoing instructions, as the cars go through the shops for general overhauling or where terminal facilities will permit. Passenger equipment cars operated in through and important service must have the packing re-

*From a paper presented before the Car Foremen's Association of Chicago, April 14, 1919.

moved, bearings inspected and boxes repacked once every six months thereafter; letters "NP," together with the date and initials of the place to be stenciled on the right-hand corner of the outside of the truck when so repacked.

Journal boxes of freight equipment cars must have the packing removed, bearings examined and boxes repacked as the cars go through the shop or on repair tracks, if the stenciling indicates that they have not been repacked within nine months. When newly packed or repacked, they must be stenciled as to the date and place of repacking.

When the movement of cars is reversed while en route, the proper adjustment of packing is very important, as it is found that the packing works to the rising side of the journal in a great many instances and will remain in that position in the reverse movement if not readjusted, causing the journals to heat, as packing in this position will not feed oil to the journal. Special instructions should be issued to the packers that where box lids are found difficult to open, they should obtain assistance from the running repairer or inspector. In no case should a box be jacked up in the yards or shops without first removing all the packing.

The most important part of the work for the successful lubrication of equipment is intelligent attention to the condition of the packing in the journal boxes, which, briefly, consists in loosening up the packing to avoid the hardened and glazed condition resulting from too long a contact with the journal, then loosening the packing by pulling it forward from the sides and working it back under the journal at the center. If new packing is needed, it should be worked back under the journal from the center by this method, thus raising the portion on the sides, care being taken that it is not lifted above the center line of the journal on either side.

When a car is found with a hot box or a mark indicating a hot box, a careful inspection must be made to ascertain the cause of heating. If the journal is smooth, a new brass should be applied and the box repacked with fresh packing. If the journal is rough, a new pair of wheels must be applied. Under no circumstances must a journal which has been heated be reapplied to a car unless it is in a perfectly smooth condition. A journal which has been heated sufficiently to discolor it, must never be reapplied to a passenger equipment car regardless of its condition in other respects.

The inspection and application of journal bearing wedges is a very important matter. In not more than one-half of one per cent of the cases where journal bearings are applied are the wedges renewed, and this is done only where the wedge lugs are badly bent or broken. This condition would indicate that the proper inspection is not made to ascertain whether or not the wedge has any crown. All new journal bearing wedges have a crown of about one-sixteenth of an inch and this crown should be maintained to obtain good results.

RECLAMATION OF JOURNAL BOX PACKING

All packing when removed from journal boxes should be pulled into a bucket, avoiding contact with the ground or any other place where it may pick up dirt, and taken to points designated on the several divisions for reclamation. In reclaiming packing, it should first be picked over carefully, the heavy dirt, metal, etc., shaken out, the knotted strands of waste pulled apart and then placed in the hot oil compartment of the "reclaiming tank." Not more than six to eight inches in depth of packing should be carried in the hot oil tank at any one time, as this insures thorough cleansing. Ten to fifteen minutes in the hot oil is sufficient. The temperatures of the oil must not exceed 180 deg. nor be less than 150 deg. The height of the oil in the hot oil compartment should be maintained to within about six inches of the top so that the waste may be washed in a pool of hot oil as it is removed.

After removal from the hot oil bath, the waste should be placed on the drainage rack on the hot oil side of the reclaiming tank and allowed to drain until the oil and water are well out of it. Only a small amount of packing should be carried on the drain rack at one time in order to facilitate drainage. After proper drainage has been effected, the waste should be transferred to the cold oil compartment for resaturation, this requiring about twenty or thirty minutes. When removed from the cold oil compartment, the packing should be placed on the drainage rack in the cold oil side of the reclaiming tank and allowed to drain until it has reached the proportion of four pints of oil per pound of waste (this condition being determined by the flow of oil under light pressure between thumb and finger), when it must be placed in a storage tank to prevent further drainage.

The hot oil compartment should be cleaned at intervals of two weeks or oftener where the volume of material handled warrants it. Oil should be extracted from all sediment removed, by pressure or drainage, and the oil thus extracted should be run through the separator and then returned to the hot oil compartment of the reclaiming tank.

The reclamation of journal box packing answers two very important purposes. First, it insures the material removed from boxes being placed back in them in a very much improved condition, so much so that the results obtained from its use where new journal bearings are applied has been very gratifying. These results are due in a measure to the reclaimed material being more thoroughly saturated than new, also forming a more compact body, thereby conveying the oil to the journal more readily. Second, it is a check against the shop doing this work; for example, a certain shop receives 10,000 lb. of prepared packing in a given period; nearly the same amount should be removed from boxes as compared with that applied. If a reasonable amount is not sent back investigation will develop that the boxes repacked have not been handled in accordance with instructions; in other words, the boxes have been overpacked or else the material removed has been carelessly thrown on the ground.

Truck conditions contribute very materially to the cause of journals heating on freight cars, as for example, the absence of nuts from column bolts and box bolts. Where the nut is missing from the column bolt, invariably the arch bar springs up, throwing the weight on the journal box and putting the box out of line. Where box bolt nuts are missing on trucks passing over low joints and crossovers, it has a tendency to allow journal bearing to become unseated from time to time with the result that packing becomes wedged between the journal and the bearing, also causing journal bearings to become broken. Cars with the arch bars worn at the column and box bolt holes, allow the box to cant inward causing the journal bearing to ride partially on the side of the journal. This defect of worn bolt holes is due primarily to nuts missing from bolts or nuts not drawn home, which allows the bolts to keep working upward and downward and also to turn when the car is in motion.

Another matter that contributes to journals heating is the absence of grease on center plates and friction side bearings. It has been found that body side bearings wearing into the truck side bearings causes the truck to bind, thereby throwing the weight to one side. This condition is due principally to center plates and side bearings not being greased. All empty cars making shop track movement should have the center plates and side bearings greased, also loaded cars where trucks have been removed. The proper time to correct these conditions, particularly on private owned cars, is when cars are home.

In order to maintain standard instructions and practices at all points on any one railroad, an experienced man with authority should be assigned to follow up this work exclu-

sively, and where this is done, a performance of approximately 150,000 miles per car per hot box on passenger equipment cars and 30,000 miles per car per hot box on freight cars has been obtained. The basis upon which this performance is compiled includes cars arriving at terminals which have caused no delay as well as those which have caused delay to the transportation department.

DISCUSSION

There was considerable discussion of the advantages and disadvantages of packing boxes without the front waste plug. The majority of members considered that better results were obtained when the plug was omitted. In connection with the reclamation of waste, attention was called to a mechanical reclamation process in which no washing oil is used. Three machines are employed, a combination oil extractor and filter, a mechanical cleaner and an impregnator which saturates the waste with oil. With this equipment it was stated that one man can reclaim 100 lb. of waste per hour.

CREOSOTE TREATMENT OF CAR TIMBERS

Methods Used by Marsh Refrigerator Service Co., Cost of the Work and Estimates of Increased Life

THE preservative treatment of lumber for use in car construction is a matter which has received considerable attention from railroads during the past few years. The possibilities for increasing the life of timber and thus reducing the cost of maintenance by such methods are now generally realized although treated lumber has not been used in the construction of cars for a sufficient length of time to determine the life which can be secured from treated sills, flooring or roofing. The method of treating cross ties and piling is different from the process used in applying preservatives to car timbers, and for that reason the life secured from structural timber when treated with preservatives does not indicate the length of service that may reasonably be expected from treated lumber used in car construction.

The Marsh Refrigerator Service Company, Milwaukee, Wis., has used the creosote treatment for sills and roofing applied to refrigerator cars for some time past. In order to determine the amount of impregnation being secured by the method of treatment used on these parts and to estimate the probable average life of the treated lumber, this company recently conducted a series of tests of the process of creosoting sills and roofing. The material creosoted consisted of standard refrigerator car sills 5 in. by 8 in. by 35 ft. and roof boards and sub-flooring 1 in. by 4 in. by 5 ft. All the lumber was southern yellow pine, the average grade being No. 1 common. The average density was approximately 8 annular rings per inch and about 30 per cent was summer wood. The lumber was all kiln-dry stock and was well seasoned, the average dry weight being 25.6 lb. per cu. ft.

TREATMENT OF SILLS

Seven sills fully framed, with mortises and tenons cut and bolt holes drilled, were taken from stock at random for the test. The individual sills were numbered and were weighed both before and after treatment. The preservatives used in the treatment of all the lumber was Carbosota, a liquid creosote oil, conforming to United States Railroad Administration specifications R 828-A. Sills numbers one to seven inclusive were subjected to a hot treatment for six hours, being completely submerged in the creosote oil, which was held at an average temperature of 150 deg. F. The steam was then shut off, and the timbers were permitted to cool for 11 hours, after which they were removed from the treating tanks and placed on a dripping rack, where they were permitted to drain for six hours. The temperature of the oil when the sills were removed was 120 deg. F.

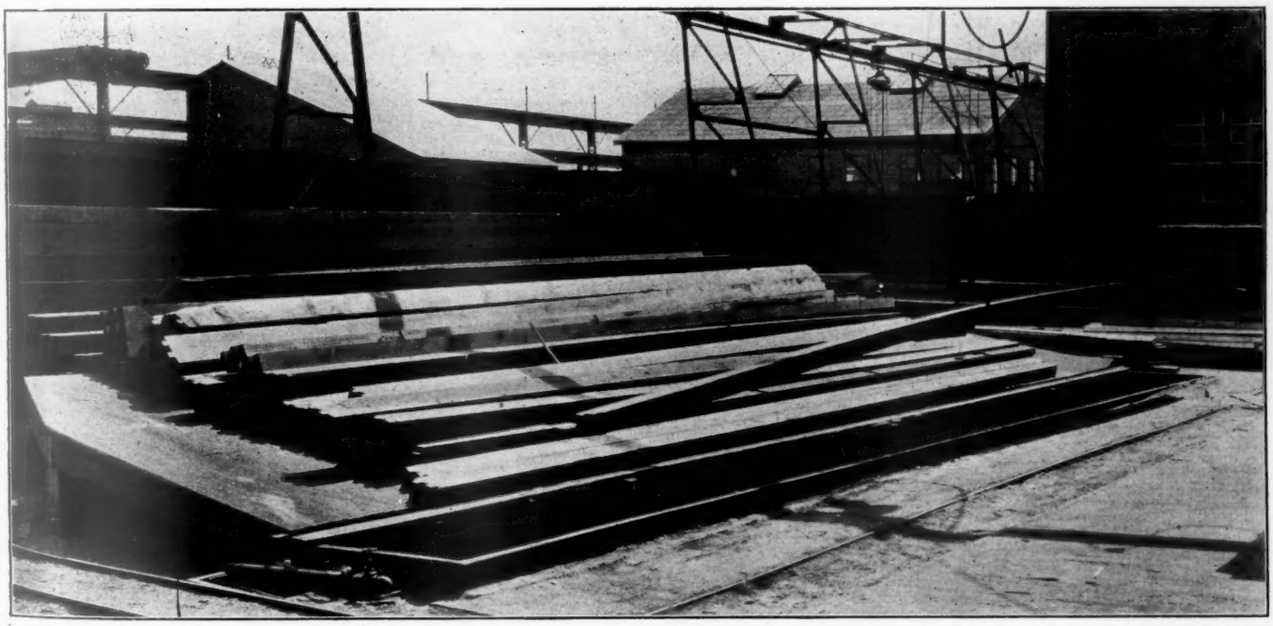


Fig. 1—Tank in Which Sills Are Treated with Creosote Oil

Sills numbers eight to ten inclusive were given a shorter treatment in the hot oil, the preservative being heated for only one hour during which the average temperature was 125 deg. F. The cooling treatment was continued for 11 hours, and upon the completion of the treatment the creosote oil was about 100 deg. F.

After draining the sills were weighed to determine the amount of creosote absorbed. The result of the treatments are shown in Table I below.

TABLE I

Weight of Sills Before and After Treatment Showing Absorption of Creosote Oil by Individual Timbers

	Estimated absorption						Moisture	
Pc. No.	Total wt. before treatment, lb.	Total wt. after treatment, lb.	Wt. per cu. ft. before treatment, lb.	Wt. per cu. ft. after treatment, lb.	Net increase per cu. ft., lb.	Lb. per surf. sq. ft.	Lb. per cu. ft.	Per cent
CHECK SPECIMENS								
1A	16.5	23.0	33.0	46.0	10.5	..	1.8	5.8
2B	27.0	58.0	27.0	58.0	28.1	..	Oven dry	..
3C	15.5	24.0	34.1	54.5	17.6	..	2.9	9.2
4D	22.0	24.0	52.4	57.1	1.9	..	18.1	52.7
CAR SILLS								
1	365.0	475.0	37.6	49.0	8.87	1.13	5.43	20.6
2	405.0	489.0	36.0	46.2	7.85	1.0	4.88	15.6
3	335.0	425.0	34.5	43.8	7.07	.9	3.34	10.7
4	350.0	449.0	36.0	46.2	7.90	1.0	4.88	15.6
5	350.0	524.0	36.0	54.0	15.24	1.9	4.88	15.6
6	352.0	483.0	36.3	49.8	11.0	1.4	5.1	16.4
7	332.0	471.0	34.2	48.5	11.90	1.5	3.03	9.7
Averages	355.6	473.7	35.85	48.24	9.97	..	4.65	15

As will be noted there was a considerable variation in the amount of creosote oil absorbed. Piece No. 2-B was impregnated throughout, the estimated absorption being 28 lb. per cu. ft. This exceptionally heavy impregnation was no doubt due to the slightly dotey condition. On the other hand, specimen 4-D absorbed only 1.9 lb. of creosote oil per cu. ft., due to the practically green condition of the timber which was also fairly dense and contained a large percentage of summer wood. Specimen 1-A is representative of the average grade of timber. This piece absorbed

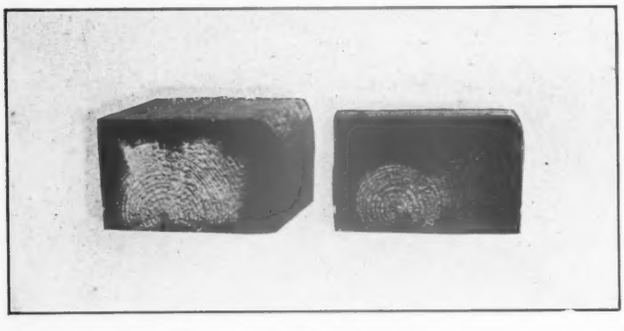


Fig. 2—Sections Through Treated Sill Showing Penetration of Creosote

about 10 lb. per cu. ft., the penetration obtained being shown in Fig. 2, which represents sections cut about 4 inches from the end and from the center of the stick. As will be noted, the portions of the timber exposed to decay have been thoroughly treated.

The average absorption of 10 lb. per cu. ft. which was obtained with sills No. 1 to 7 inclusive indicates the possibilities of the open tank method of treatment with refined coal tar creosote oil under proper conditions. The lack of penetration in the case of piece 4-D shows the need for thorough seasoning of wood to be treated by the non-pressure process. Unless the wood is thoroughly dried satisfactory results are in most cases not obtained.

The results obtained on sills No. 8 to 10 are shown in Table II.

TABLE II

Weight of Sills and Absorption of Creosote with Short Treatment in Hot Oil

	Estimated absorption							Moisture	
Pc. No.	Total wt. before treatment, lb.	Total wt. after treatment, lb.	Wt. per cu. ft. before treatment, lb.	Wt. per cu. ft. after treatment, lb.	Increase in wt. per cu. ft., lb.	Lb. per surf. sq. ft.	Gals. per 100 sq. ft. surf.	Lb. per cu. ft.	Per cent
8	312.5	340.5	32.23	35.10	2.87	.368	4.1	1.03	3.3
9	365.0	381.0	37.63	39.28	1.65	.210	2.3	6.43	20.6
10	342.5	370.0	35.31	38.14	2.83	.361	4.0	4.11	13.2
Averages	...	...	35.06	37.51	2.45	.313	3.5	3.86	12.37

The small absorption in these specimens proves the necessity for a long hot treatment. As an approximate rule it may be stated that wood naturally resistant to the injection of creosote oil should be immersed one hour for each inch of the largest cross section in both the hot and cold bath. When treating woods not difficult to impregnate this time may be reduced one half. This applies to treatments where separate hot and cold baths are used, but where the timbers are left in the hot creosote oil until it cools, the cooling treatment should be carried on for 10 to 12 hours.

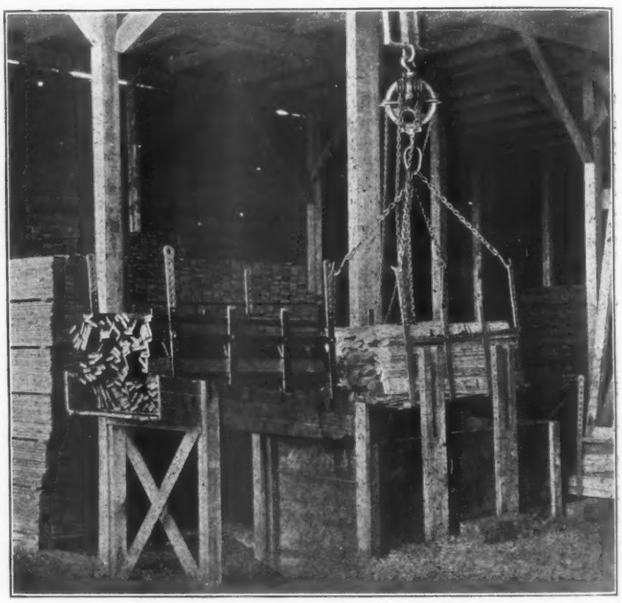


Fig. 3—Devices for Handling Roof Boards During Treatment

The theory of the process described above is that during the hot treatment the heat of the preservative expands and expels a portion of the air and water contained in the wood cells. Then upon immersion in the cold bath or upon the gradual cooling there is a partial contraction and the condensation of the air and water remaining in the wood results in a slight vacuum being formed. This, aided by atmospheric pressure and capillary action between the wood cells and the preservative, causes the actual impregnation with oil.

TREATMENT OF ROOF BOARDS AND SUBFLOORING

Ten pieces of roofing material 1 in. by 4 in. by 5 ft., taken at random from stock, were numbered and weighed. These pieces were then bundled together and were creosoted by immersion in the heated creosote oil only. Because of the small cross section of this lumber the standard open tank process used in treating the sills was not required. Pieces No. 0 to 9 inclusive were submerged for a period of 45 min. at an average temperature of 160 deg. F. They were then

removed from the tank and allowed to drain, after which they were weighed to determine the absorption of creosote oil. The impregnation was somewhat greater than is necessary under the conditions of service for which this material is used. The average absorption secured by this method, as shown in Table III, was approximately 6.55 lb. per cu. ft. The expense of such treatment would probably not be warranted for this material.

TABLE III

Absorption of Creosote by Roof Boards Immersed for 45 Minutes

1	2	3	4	5	6	7
Pc. No.	Total wt. before treatment, lb.	Total wt. after treatment, lb.	Total increase in wt., lb.	Wt. per cu. ft. before treatment, lb.	Wt. per cu. ft. after treatment, lb.	Est. absorpt'n increase in wt. per cu. ft., lb.
0	2.81	3.25	0.43	20.23	23.38	3.15
2	2.55	3.68	1.03	19.10	26.52	7.42
5	3.06	3.07	0.01	22.03	22.14	0.11
6	2.75	3.12	0.37	19.78	22.48	2.7
7	3.81	3.89	0.07	27.43	27.99	0.56
Averages	3.29	4.20	0.91	23.69	30.24	6.55

Pieces No. 10 to 19 inclusive were submerged in the creosote oil for 30 min. at an average temperature of 153 deg. F. The absorption as shown in Table IV indicates that the results are satisfactory for the purpose, the average absorption being about 2½ lb. per cu. ft.

TABLE IV

Absorption of Creosote by Roof Boards Immersed for 30 Minutes

Pc. No.	Total wt. before treatment, lb.	Total wt. after treatment, lb.	Total increase in wt., lb.	Wt. per cu. ft. before treatment, lb.	Wt. per cu. ft. after treatment, lb.	Est. absorpt'n increase in wt. per cu. ft., lb.
10	2.84	3.07	0.234	20.46	22.14	1.68
11	3.09	3.21	0.125	22.24	23.15	0.91
12	3.40	3.43	0.031	24.51	24.73	0.22
13	2.59	3.06	0.468	18.66	22.03	3.37
14	3.93	6.00	2.062	28.33	43.17	14.84
18	3.53	3.60	0.078	25.40	25.96	0.56
19	3.87	3.93	0.062	27.87	28.32	0.45
Averages	3.55	3.88	0.331	25.56	27.94	2.38

CARING FOR TIMBER BEFORE TREATING

The proper drying of lumber before treating is of great importance, but satisfactory results can be secured with stock that has been thoroughly air dried. Timber should be piled in such a manner as to permit a constant circulation of air around each individual piece, and care should be taken to avoid contact with wood that has started to decay. If creosoted sills are available they should be used as the foundation for the pile. In no case should timber be piled on cinder fillings or where vegetation can come in direct contact with it. Sills before being placed in the creosote oil should be fully framed and all mortises and tenons should be cut and all bolt holes drilled.

EQUIPMENT USED FOR CREOSOTING

The equipment required for treating lumber with creosote oil is extremely simple, and both the initial cost and the cost of operation are low. The tank in which sills are treated at the plant of the Marsh Refrigerator Service Company is shown in Fig. 1. It is about 50 ft. long, 4 ft. wide and 4 ft. deep, with steam coils in the bottom for heating the oil, and is located in a portion of the yard served by a crane, which greatly facilitates handling the timber. It has been found that some lumber will float in the creosote, and to correct this the tank is to be fitted with a device for holding down the sills during treatment.

For treating the roof boards and the subflooring a smaller tank is used, shown in Fig. 3. This tank is made of wood lined with tin, and is 3 ft. wide, 6 ft. long and 2 ft. 6 in. deep. The boards to be creosoted are piled loosely in frames made of iron bars. About 150 to 200 pieces are placed in the frame which is raised by a chain hoist and lowered into the creosote. Levers attached to the frame above the tank are used to insure complete immersion of the lumber. After being treated about 30 min. the frame is placed on the drying rack to allow the surplus oil to drain off, after which the material is ready to be placed in storage.

The timber which has been creosoted, particularly the subflooring and roofing, is given an opportunity to dry thoroughly before it is placed in the cars. With the refined coal tar creosote oil the material dries readily in from two to three days during fair weather. In order to permit of keeping on hand a stock of dry creosoted material sufficient to meet the requirements, storage space is provided for an extra stock in excess of that required to permit the material to dry. Roofing and flooring is treated during the summer months in sufficient quantities to provide a supply to last through the winter, as this work can be more readily handled during the warm weather.

COST OF PRESERVATIVE TREATMENT

The average cost of treating sills 5 in. by 8 in. by 35 ft. has been estimated as follows:

Creosote oil, 10 lb. per cu. ft. for 9.7 cu. ft. (10.8 gal.)	$4.00
Labor and overhead	.50
Total cost per sill	4.50
Cost per thousand feet, board measure	38.54

In treating the subflooring and roofing two men handle approximately 400 pieces per hour, making the labor cost per piece $.0005. Overhead is estimated at $.0005 and the cost of creosote oil at 8 lb. per sq. ft. of surface makes a total cost per piece of about $.018 or $10.65 per thousand feet board measure.

ECONOMY OF TREATED MATERIAL

It is estimated that the treatment of lumber for refrigerator cars will result in a large saving. The average life of untreated roofing boards has been found to be approximately six years. Creosoted material in the same location, unless destroyed by abrasion, should last from 12 to 15 years. The life of the sills should be correspondingly increased. The savings effected will be much greater than would be indicated by the reduction in cost of the material over a given period of years, especially in the case of the sills, as the replacement of these parts entails not only a loss equal to the value of the sill and the labor of applying it, but also the value of such other material as may be destroyed or made unfit for further use in replacing the decayed sills.

TRACK CURVATURE IN CAR DESIGN

BY ALBERT H. LAKE, JR.

In the design of the modern railroad car having pivoted trucks, it is necessary to know the radius of track curvature over which the car will pass without interference of the wheels with the car body, the brake rods or the brake pipe, and also to ascertain if the striking plate is of sufficient depth to avoid interference at the corner of the car or push pole pocket.

With the following formulae and table, used in connection with Figs. 1 and 2, these clearances may easily be calculated. The angle A and the distance H may be found by the use of Fig. 1 and the formulae. Referring to Fig. 1:

A = The angle formed by lines drawn from the truck center and the center of the car to the radius point O and is also the angle formed by the center lines of the car and of the truck, as these angles are always equal.

B = The angle formed by lines drawn from the pulling face of the coupler, with the horn against the striking plates, and the center of the car to the radius point O.

C = Distance from center to center of trucks.

D = ½ C.

E = Distance from the center of the truck to the face of the end sill or interference point at the corner of the car.

F = Distance from the center line of the car to the face of the side sill or interference point at the corner of the car.

G = Distance from center of car to the radius point O.

H = Distance from the face of the end sill or interference point at the corner of the car to the pulling face of the coupler with the horn against the striking plate.

$K = G - F$.

R = Radius of track curvature.

With the foregoing values the formulae are:

(1) Sine A = D ÷ R

(2) G = R × cos. A.

(3) K = G − F (R × cos. A) − F.

(4) $\text{Cot. } B = \dfrac{K}{D+E} = \dfrac{(R \times \cos. A) - F}{D+E}$

(5) $H = \underset{(D+E)}{(G \times \tan. B)} - (D + E) = [(R \times \cos A) \times \tan. B] -$

The following example will illustrate the use of the formulae for Fig. 1. Let $R = 100$ ft. 0 in., $C = 30$ ft. 0 in.,

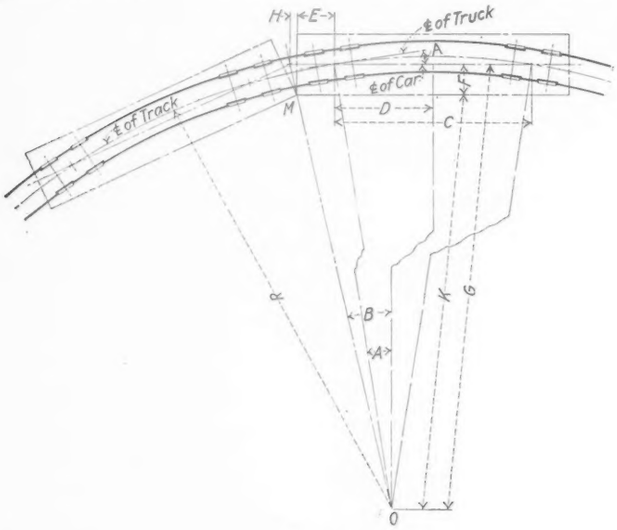


Fig. 1

$D = 15$ ft. 0 in., $E = 5$ ft. 6 in. and $F = 4$ ft. 9 in. From the table the angle $A = 8$ deg., 38 min. and cosine $A = 0.9886$.

Using formula (4)

$$\text{Cot. } B = \frac{(100 \times 0.9886) - 4.75}{15 + 5.5} = \frac{94.11}{20.5} = 4.59073$$

B = 12 deg., 17 min.; tan. B = 0.2177

Using formula (5)

H = [(100 × 0.9886) × 0.2177] − (15 + 5.5) = 21.52 − 20.5 = 1.02 ft.

It should be noted that formula (5) for the distance H does not consider the swing of the coupler sidewise, which varies to suit the detail of the striking plate.

Fig. 2 is used to find the distance of the highest point of the wheel flange from the center line of the car and also the travel of the truck side bearing. Referring now to Fig. 2:

A = The angle between the center line of the car and the center line of the truck, also between the center lines of the body and truck bolsters, and the axles.

B = The distance from the center line of the car to the center line of the side bearing.

C = Travel of the truck side bearing.

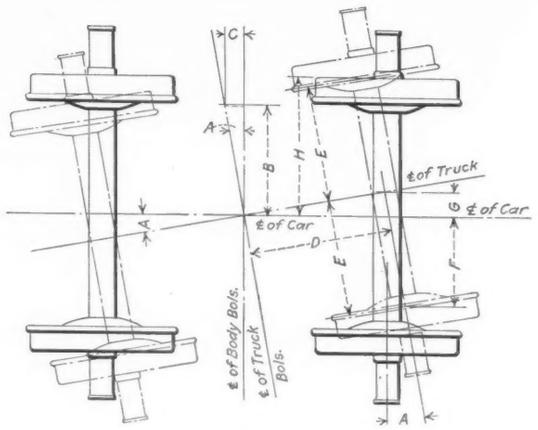


Fig. 2

D = The distance from the center line of the truck to the center line of the axle.

E = The distance from the center line of the truck to the highest point on the wheel flange.

F and H = The distance from the highest point on the wheel flange to the center line of the car.

G = The distance from the center line of the car to the center line of the truck at the axle.

The angle A is the same as in Fig. 1 and is found by formula (1) or from the table.

With these values the formulae for Fig. 2 are:

(6) C = B × sine A

(7) G = D × sine A

(8) F = (E × cos. A) − G = (E × cos. A) − D × sine A)

(9) H = (E × cos. A) + G = (E × cos. A) + (D × sine A)

The following example will illustrate the use of the formulae for Fig 2. Let $A = 8$ deg., 38 min.; $B = 2$ ft. 1 in.; $D = 2$ ft. 9 in., and $E = 2$ ft. 3¼ in. From the table, sine $A = 0.1500$; cos. $A = 0.9886$.

Using formula (6)

C = 2 ft. 1 in. × 0.1500 = 3.75 in.

Using formula (8)

F = (2 ft. 3¼ in. × 0.9886) − (2 ft. 9 in. × 0.1500) = 21.99 in.

Using formula (9)

H = (2 ft. 3¼ in. × 0.9886) + (2 ft. 9 in. × 0.1500) = 31.89 in.

For convenient reference the data may be calculated and tabulated as shown in the table.

TABLE GIVING THE ANGLE A AND THE CORRESPONDING SINE AND COSINE FOR FOR THE RADII OF CURVATURE AND TRUCK CENTERS

Ctr. to ctr. of trucks	80 ft. radius			100 ft. radius			120 ft. radius			140 ft. radius		
	Angle A	Sine	Cosine	Angle A	Sine	Cosine	Angle A	Sine	Cosine	Angle A	Sine	Cosine
20 ft. 0 in	7° 11′	0.1250	0.9921	5° 45′	0.1000	0.9949	4° 47′	0.0833	0.9965	4° 6′	0.0714	0.9974
21 ft. 0 in.	7° 33′	0.1312	0.9913	6° 2′	0.1050	0.9944	5° 1′	0.0875	0.9961	4° 18′	0.0750	0.9971
21 ft. 6 in.	7° 43′	0.1343	0.9909	6° 10′	0.1075	0.9942	5° 8′	0.0895	0.9959	4° 24′	0.0767	0.9970
22 ft. 0 in.	7° 54′	0.1375	0.9905	6° 19′	0.1100	0.9939	5° 15′	0.0916	0.9958	4° 30′	0.0785	0.9969
22 ft. 6 in.	8° 7′	0.1412	0.9899	6° 28′	0.1125	0.9936	5° 23′	0.0937	0.9956	4° 36′	0.0803	0.9967
23 ft. 0 in.	8° 16′	0.1437	0.9896	6° 36′	0.1150	0.9933	5° 30′	0.0958	0.9954	4° 43′	0.0821	0.9966
24 ft. 0 in.	8° 38′	0.1500	0.9886	6° 54′	0.1200	0.9927	5° 45′	0.1000	0.9949	4° 55′	0.0857	0.9963
24 ft. 6 in.	8° 49′	0.1531	0.9881	7° 2′	0.1225	0.9924	5° 52′	0.1020	0.9947	5° 1′	0.0875	0.9961
25 ft. 0 in.	8° 59′	0.1562	0.9877	7° 11′	0.1250	0.9921	5° 59′	0.1041	0.9945	5° 7′	0.0892	0.9960
25 ft. 6 in.	9° 10′	0.1593	0.9872	7° 20′	0.1275	0.9918	6° 6′	0.1062	0.9943	5° 13′	0.0910	0.9958
26 ft. 6 in.	9° 32′	0.1656	0.9861	7° 37′	0.1325	0.9911	6° 20′	0.1104	0.9939	5° 26′	0.0946	0.9955
27 ft. 0 in.	9° 43′	0.1687	0.9856	7° 46′	0.1350	0.9908	6° 28′	0.1125	0.9936	5° 32′	0.0964	0.9953
27 ft. 6 in.	9° 54′	0.1718	0.9851	7° 54′	0.1375	0.9905	6° 35′	0.1145	0.9934	5° 38′	0.0982	0.9951
28 ft. 6 in.	10° 16′	0.1781	0.9839	8° 12′	0.1425	0.9897	6° 49′	0.1187	0.9929	5° 51′	0.1017	0.9947
29 ft. 0 in.	10° 27′	0.1812	0.9834	8° 20′	0.1450	0.9894	6° 56′	0.1208	0.9926	5° 57′	0.1035	0.9946
29 ft. 6 in.	10° 38′	0.1843	0.9828	8° 29′	0.1475	0.9890	7° 4′	0.1229	0.9924	6° 3′	0.1053	0.9944
30 ft. 0 in.	10° 49′	0.1875	0.9822	8° 38′	0.1500	0.9886	7° 11′	0.1250	0.9921	6° 9′	0.1071	0.9942
31 ft. 0 in.	11° 10′	0.1937	0.9810	8° 55′	0.1550	0.9879	7° 25′	0.1291	0.9916	6° 21′	0.1107	0.9938
32 ft. 0 in.	11° 33′	0.2000	0.9797	9° 13′	0.1600	0.9870	7° 40′	0.1333	0.9910	6° 34′	0.1142	0.9934
33 ft. 0 in.	11° 54′	0.2062	0.9785	9° 30′	0.1650	0.9862	7° 54′	0.1375	0.9905	6° 46′	0.1178	0.9930
33 ft. 6 in.	12° 5′	0.2093	0.9778	9° 39′	0.1675	0.9858	8° 1′	0.1395	0.9902	6° 52′	0.1196	0.9928
34 ft. 6 in.	12° 27′	0.2156	0.9764	9° 56′	0.1725	0.9850	8° 16′	0.1437	0.9896	7° 5′	0.1232	0.9923
35 ft. 0 in.	12° 38′	0.2187	0.9757	10° 5′	0.1750	0.9845	8° 23′	0.1458	0.9893	7° 11′	0.1250	0.9921

SHOP PRACTICE

DRILLING HOLES FOR HUB PLATE STUDS

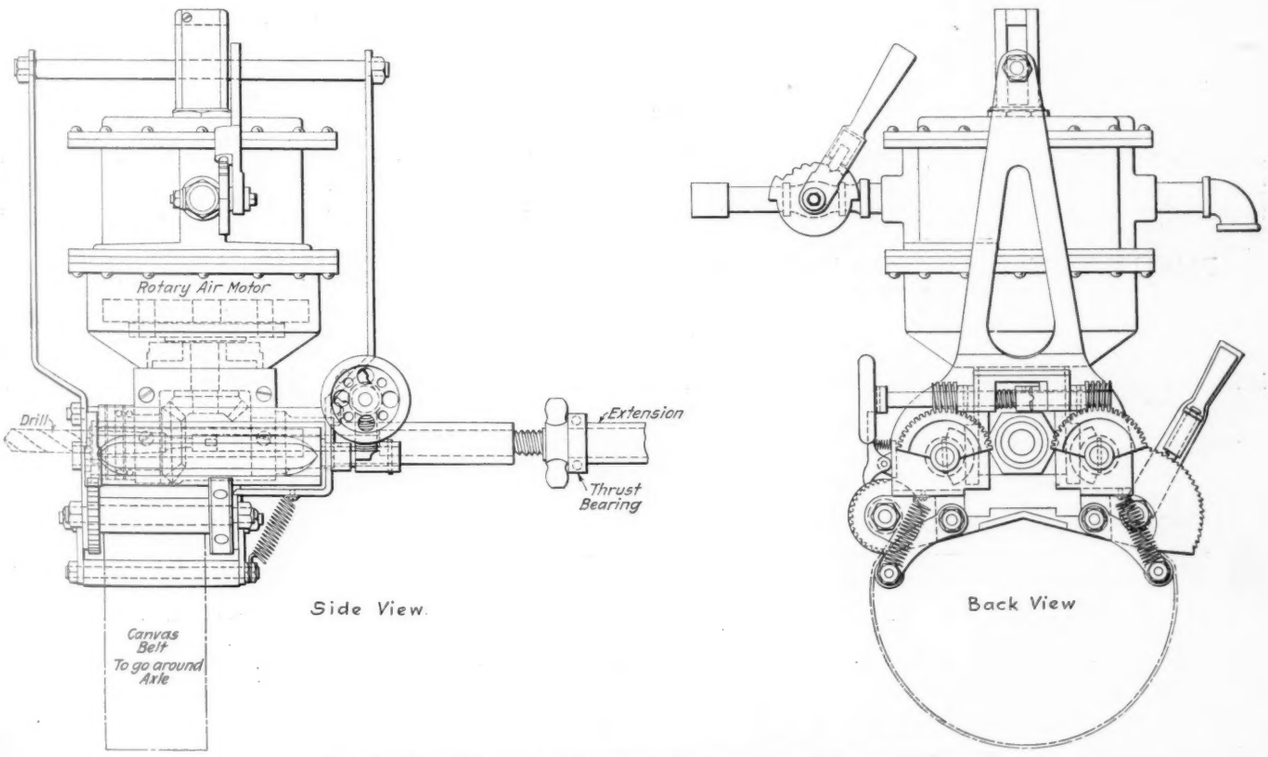
The work of drilling holes in driving wheel centers for holding hub plate studs is not easily performed with the ordinary air motor mainly on account of the difficulty of applying an "old man" on the axle. Furthermore, it is often difficult to get the proper alinement of the drill and air motor.

An ingenious device which saves considerable time in doing this work has been devised in the West Burlington shops of the Chicago, Burlington & Quincy, where it has been used with great success for some time.

This machine, drawings of which are shown herewith, is arranged to clamp on the axle. It supports an air motor which drives a drill spindle, these parts being adjustable to bring the drill to any desired distance from the axle. The frame, *A* and *B*, is of 3/16 in. sheet steel with heavier sections welded on where necessary for bearings or other parts. On the lower end of this frame at one side is a spool which holds one end of a canvas belt 3⅜ in. wide and 2 ft. 10 in. long. The spool is fitted with a ratchet on one end and a wheel arranged with sockets for a short bar on the other end. The opposite end of the belt is attached to a tightener which is arranged to slip into the socket bearings *L*. To apply the machine it is set in place, the belt is slipped around the axle and the tightener is set in the sockets. The belt can then be adjusted by turning the spindle and tightened by pressing down the handle *K*.

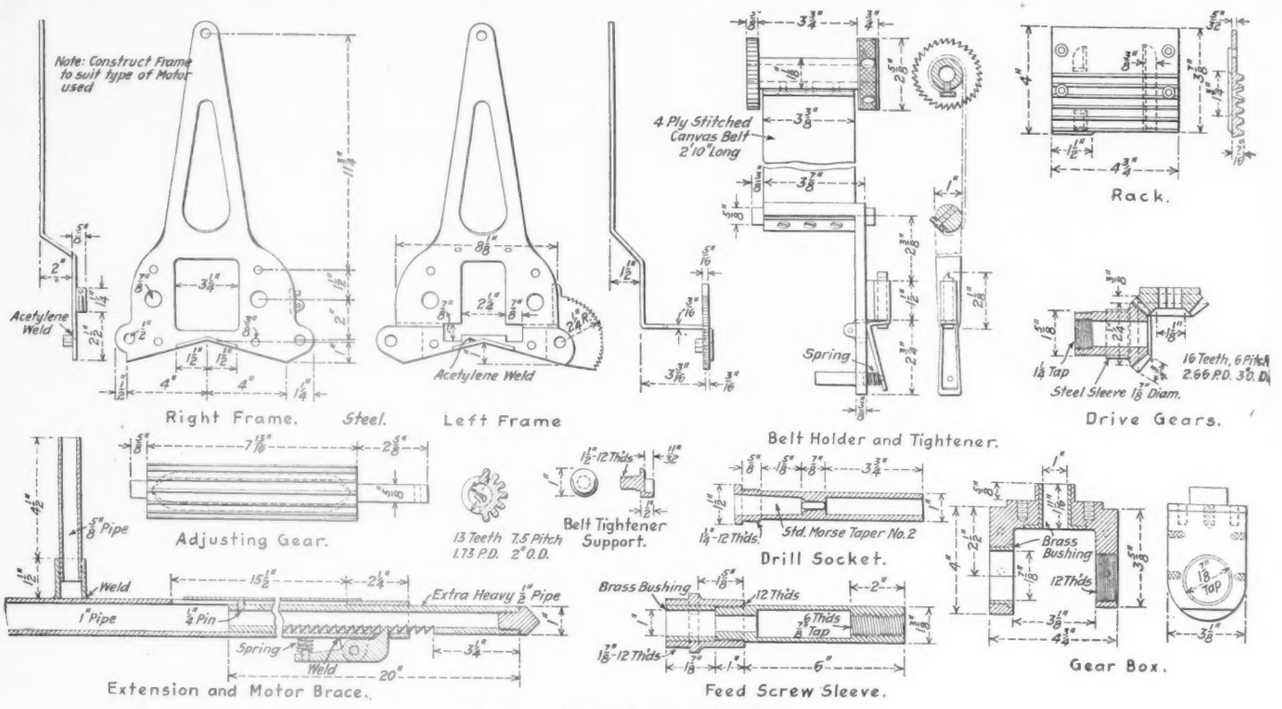
The distance of the spindle from the axle is controlled by a hand wheel on the shaft *X*. This shaft carries right hand and left hand worms, and these engage worm wheels keyed to the shaft of two segmental adjusting gears. The adjusting gears in turn engage racks on the sides of the gear box which carries the drill spindle and driving gear. Thus by turning the hand wheel on the shaft *X* the spindle is moved radially toward or away from the axle. The width of the rack on the side of the gear box is 3 in. less than the length of the adjusting gears so the drill can be moved that distance parallel to the axle without resetting, this amount of adjustment being ample for the work on which the machine is used. The drill is fed by a hand wheel *R* which turns a feed screw *Q* in the sleeve *P* attached to the gear box, the extension *S* on the feed screw extending to the hub of the opposite wheel.

The drive is simple and is clearly shown in the illustration. The air motor is attached directly to the gear box, the end opposite the spindle being held by a guide which spans



End and Side Elevation of Device for Drilling Driving Wheel Hubs

a rod across the frame. The bevel gear on the motor spindle engages another bevel gear which carries a socket for a No. 2 Morse taper shank, the inner end of which extends into the end of the barrel of which is secured the special split fitting shown at *3* in the drawing. This is held in place by means of the nut *2*. The shank of the tamper works



Details of the Hub Drilling Device

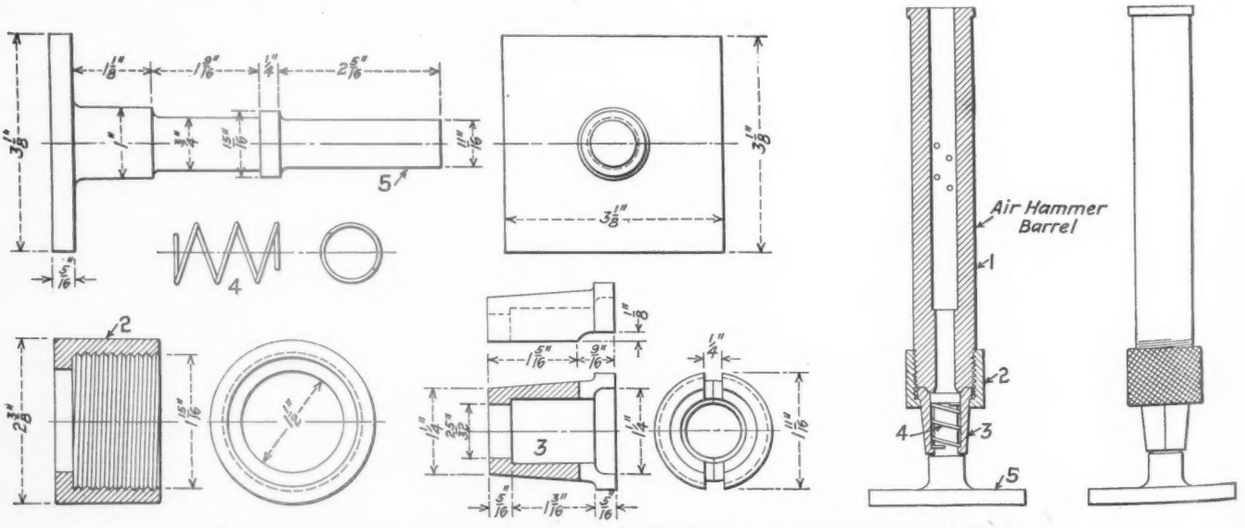
a bearing in the feed screw sleeve. The gear which carries the drill socket has a ball thrust bearing and lock nuts on the end of the hubs which hold it in place in the gear box.

PNEUMATIC TAMP FOR THERMIT WELD MOLDS

BY J. F. D.

The practice on most railroads in making Thermit welds is to tamp up the mold box by hand. This is a rather long and tedious operation. Better results may be obtained and the time required reduced 75 per cent by using the tamping tool shown in the illustration.

The tool is designed for use with a small air hammer, to inside the fitting *3;* a coiled spring shown at *4* on the drawing is arranged within the fitting to effect the return stroke of the tamper after the blow of the hammer has driven it out.



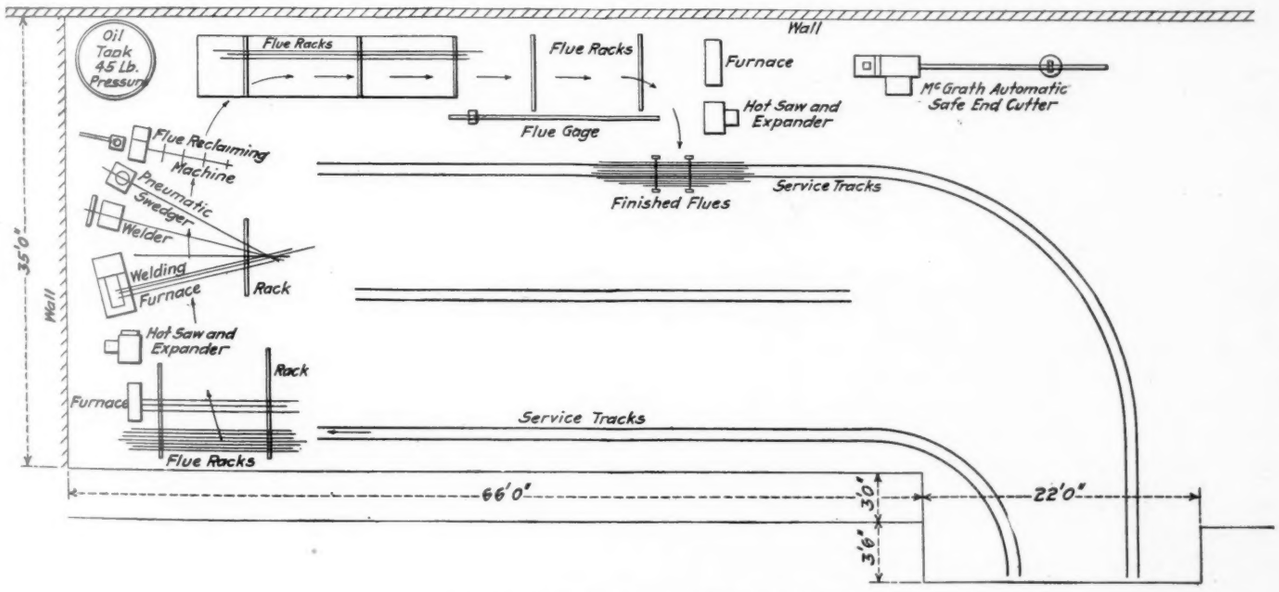
Details of Pneumatic Hammer Tamping Attachment for Use on Thermit Weld Molds

GAGE DIFFICULTIES IN AUSTRALIA.—The Federal railway authorities in Australia have had offered for their consideration no fewer than 126 different devices to meet the break of gage difficulty, but none has found favor. They are of the following types: Sliding wheel, 23; double or multiple wheels, 40; telescopic and divided wheels, 9; adjustable truck frame, 3; changing truck, 7; transference of bodies, 13; treble or multiple rails, 6; unclassified, 25.

E. J. & E. Has Efficient Flue Shop

Rapid Production Secured with Small Force and Few Machines; Data on the Cost of Operation

THE locomotive repair shop of the Elgin, Joliet & Eastern at Joliet, Ill., has a flue shop which has made splendid records for high output and low unit cost. The plant includes a number of novel features which facilitate rapid production. One of the unusual points in connection with this layout is the fact that all the flue work excepting the removal of scale is handled on a balcony in the boiler department. In designing the shop it was thought desirable to provide ample room for the flue shop, and since the plan of the main floor did not present a favorable opportunity for securing the required space, the question of locating the department on the balcony was considered. The objection to this plan was the increased difficulty of handling the material. On the other hand, there were numerous advantages. The location on the balcony would keep the smoke and heat from the furnaces out of other parts of the shop, it would remove the tendency to encroach on the space devoted to flue work, and by reducing the space required on the ground floor would make a more compact layout possible.



Layout of Flue Machinery on the Balcony

The locomotive repair shop at Joliet is of the longitudinal type, approximately 400 ft. by 150 ft. The erecting bay extends along one side of the building. On the other side is a heavy machine bay served by a traveling crane and a light machine bay 35 ft. wide with a balcony. It was finally decided to locate the flue cleaner in the heavy machine bay with the remainder of the flue shop equipment on the balcony. A passageway 3 ft. wide extends along the balcony outside the columns on which the overhead crane runs, and by adding 3 ft. 6 in. to the width of the extension for a space of 22 ft. a landing stage was provided on which a set of flues can readily be handled. The flue shop was assigned a space about 35 ft. by 80 ft., which has proved ample for the work; in fact, a part is regularly used for storage purposes.

The layout of the machines in the shop is shown in the drawing reproduced herewith. Service tracks lead from the balcony to the first and last machines used in repairing the tubes, and in addition there is a storage track along the center. The tool equipment comprises two McGrath tube furnaces, two hot saws and pneumatic expanders (one equipped with a safe end magazine), a McGrath flue welding furnace, a Hartz flue welder, a Draper pneumatic flue swedger, a gaging stand, roller flue racks, a Ryerson boiler tube reclaiming machine and a McGrath safe end machine.

The operation of cutting the small tubes out of the boiler is performed in the usual manner by means of an air motor connected through a flexible joint to an expanding cutter. The large superheater flues are cut out of the boiler by the use of an oxy-acetylene cutting torch. The back ends of the tubes are cut out with an air hammer, after which the tubes are passed out through the front tube sheet and stacked on substantial standards built up of channels and flat bars, as shown in Fig. 1. The set of tubes or flues after being removed from the locomotive is picked up with chains attached to a yoke and set on stands, as shown in Fig. 2, until they are taken to the flue cleaning machine. The standards are of simple construction and provide ample space for passing chains around the tubes. The sets of tubes can be stacked one above another, and the space required is reduced to a minimum.

When the tubes are ready for cleaning they are taken to the flue cleaner or rattler, which is of the Ryerson pit type, and is shown in Fig. 3. An entire set of flues can be hoisted in chain slings and lowered into the pit onto the rolling chains of the rattler. The ends of the sling chains are fastened to hooks on the sides of the pit and left in position during the cleaning operation, as the flues rest on the rolling chains, and there is sufficient clearance between the tubes and the walls of the pit to keep the tubes from coming in contact with the chains. The tubes or flues are left in the rattler for from two to six hours, depending on the thickness and character of the scale. After the cleaning operation is completed, the sling chains are again hooked to the crane and

the flues are raised out of the rattler and washed off with a hose, after which they are carried up to the balcony and deposited on the service track in the flue department, as indicated in the layout drawing.

The force employed in repairing tubes consists regularly of four men. The first man operates the hot saw, cutting off the rear end of the tubes, the second welds the safe end on the tube and swedges it, while the third cuts the front end of the tube and expands it. The fourth man is a helper, who assists in handling the tubes. When working on tubes more

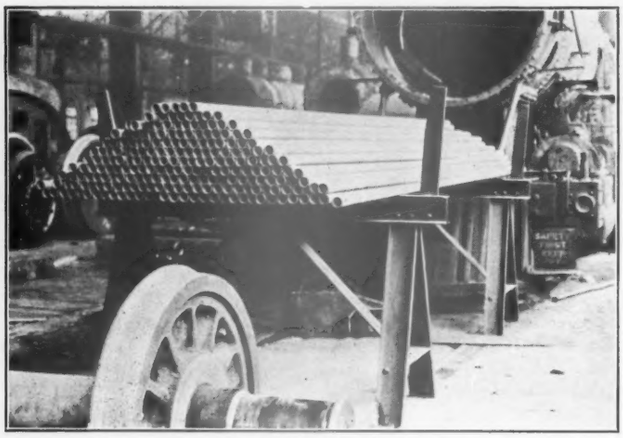


Fig. 1.—Tubes Removed from the Locomotive Are Piled on Special Standards

than 18 ft. long an additional helper is required on account of the difficulty of manipulating the longer tubes.

The tubes undergoing repairs follow a predetermined course through the flue shop, as indicated on the floor plan by the series of arrows. From the car on the service track the flues are deposited on the roller flue rack adjacent to the first oil furnace. The front end of the tube is plugged with waste and the rear end is put into the furnace. Three or four flues are kept heating at one time to provide heated tubes as fast as they can be handled through the hot saw and

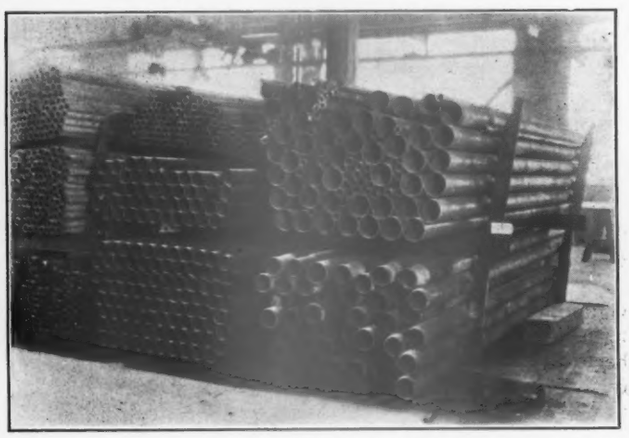


Fig. 2.—Tubes and Flues Stacked to Occupy Minimum Space

expander. The tube is heated just above the cherry red, and is then cut off in the hot saw shown in Fig. 4. The end is then inserted in the pneumatically operated expander. The movement of the expander is controlled by a hand-operated lever, which is arranged so that the movement of the latch operates the dies which hold the tube. Moving the lever forward opens a second valve, which forces the expander into the tubes and also releases a safe end from the safe end magazine at the side. The tube is next released from the expander, the safe end is forced into the end and the operator lifts the end of the tube over his head and inserts it in the welding furnace. The series of operations performed between

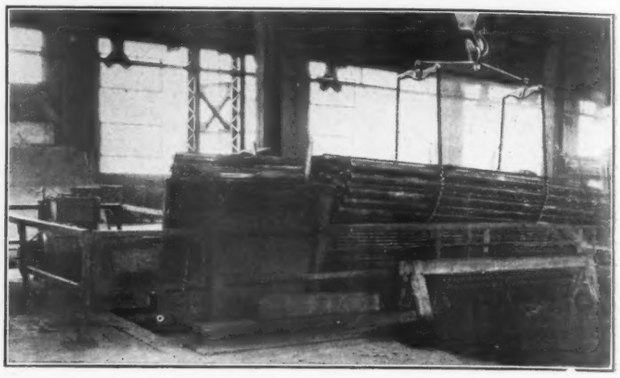


Fig. 3.—A Set of Flues About to Be Lowered Into the Pit Type Rattler

the first heating furnace and the welding furnace requires only five to seven seconds.

The welding furnace is especially designed for flue work

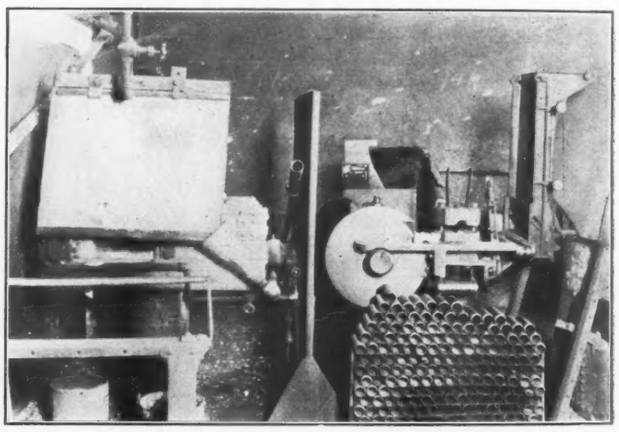


Fig. 4.—Furnace With Water Shield and Hot Saw and Expander With Safe End Magazine

and has three openings. The two openings farthest from the combustion chamber bring the metal up to a white heat, after

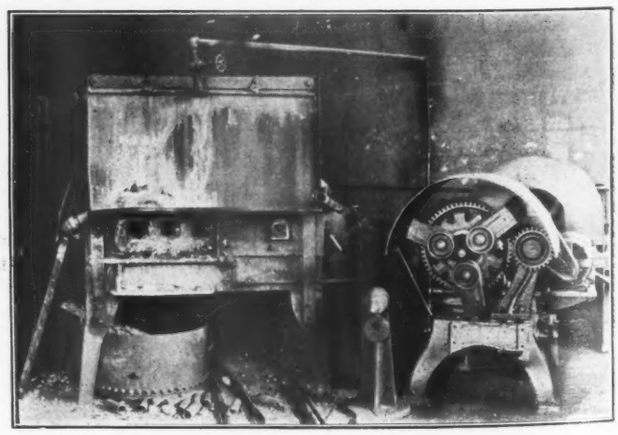


Fig. 5.—Welding Furnace and Roller Flue Welder

which it is placed in the opening nearest the combustion chamber for a few seconds, where the oxidizing flame brings it to a welding heat. The operator then removes the tube

from the furnace and places it on the mandrel of the Hartz flue welder. By pressing down a treadle on the machine the revolving rollers are brought against the joints, welding the safe end to the tube. The operator then inserts the end of the safe end into the pneumatic swedger, reducing the size at the end and thus finishing the operation on the firebox end of the tube. The waste is then removed from the forward end of the tube and it is carried over to the roller flue rack and is pushed up within reach of the operator on the second hot saw.

The operation on the front end of the tubes consists in

Fig. 6.—Roller Flue Racks Serving Second Hot Saw and Gaging Stand

cutting to length and expanding slightly. The tube is inserted in the furnace until it is brought to the proper temperature for cutting. It is then removed and the back end is placed in the channel on the stop shown in Fig. 6, which has been set at the proper distance from the hot saw to make the tube precisely the length required. The tube is then placed in the expander with the back end resting against the angle stop, which brings it forward the proper distance to secure the required amount of expansion in the end of the tube. The finished tube after being removed from the ex-

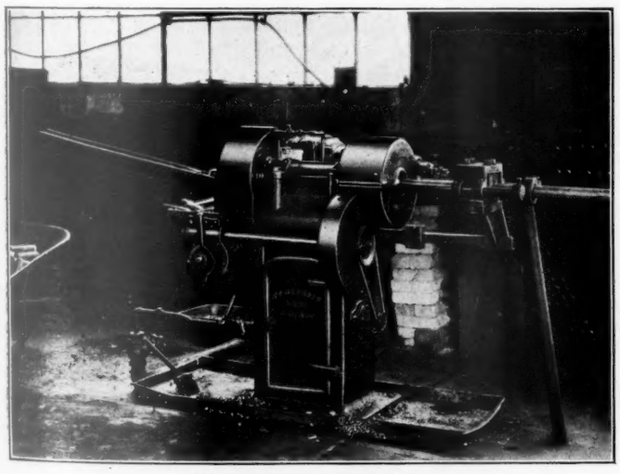


Fig. 7.—Automatic Machine for Cutting Safe Ends Reduces Labor in the Flue Shop

pander is placed on a car on the outgoing service track. The operator who works on the front end of the tubes marks them to indicate the various lengths and also attends to the automatic safe end machine, which is located just beyond the hot saw and expander. It will be noted that the tubes are not tested after being welded until they are subjected to pressure in the boiler. This policy was adopted because it was found that the proportion of defective welds was so small as to make testing of the individual tubes unnecessary.

The standard practice on the E. J. & E. is to apply not more than four safe ends on tubes or flues. When tubes are removed from the boiler which have been pieced four times they are cut and either used on smaller engines or have a single long tube welded on the end in the flue reclaiming machine. Superheater flues are handled with the same equipment used on the small tubes, the only alteration necessary being changes in the minor parts of some of the machines.

Records have been taken in the flue shop to determine the time required to finish a complete set of tubes. On one occasion, when the operators were working under favorable conditions, eight two-inch tubes 18 ft. long were completed in 2 min. and 40 sec., which is at the rate of a tube every 20 sec. or 108 tubes an hour. Another test was made with 47 two-inch tubes 22 ft. long, which were completed in 24 min. or at a rate of 117 tubes an hour. A third test on 22 two-inch tubes 18 ft. long required 8 min. 18 sec., or a rate of 158 tubes an hour.

The cost of applying safe ends to the tubes depends somewhat on the length of the tubes, the longer tubes requiring an extra helper. Including the cost of power for the rattler, oil and air for the furnaces, and labor for safe ending and cutting, the total cost for 18-ft. tubes will vary from 1.91 cents per tube at the rate of 180 per hour, to 3.18 cents at the rate of 100 an hour. For 22-ft. tubes the cost will be 2.16 cents per tube at 180 an hour, and 3.3 cents at 100 tubes an hour.

UNIFIED SHOP RECORD AND MANAGEMENT CONDITIONS

A committee was recently appointed from several roads in the Eastern Region, assisted by a representative from the mechanical department of the United States Railroad Administration, to visit a number of representative shops, collect data, and make a report as to the various methods of shop operation, supervision and shop records. Copies of the recommendations of the committee have been sent out to the federal and general managers of the Eastern Region by the regional director with Circular 1801-129A674, which states that while not mandatory, the recommendations if gradually adopted will secure uniformity in shop records and simplify many of the methods of procedure. The circular also suggests that, where no system is in use, the proposed plan may well be adopted. Reports are asked for as to what action is taken on the committee's recommendations.

The recommendations of the committee include the following:

SUPERVISION

The committee has paid particular attention to that supervision which comes in direct contact with the men, and invariably where the number of men assigned to one supervisor exceeded 30, a lack of activity was noticed.

It is generally conceded that shops on a day-work basis require more supervision than those on piece work, and after careful consideration it is recommended that the plan of assigning not more than 30 men to one foreman be adhered to as closely as practicable. The committee further recommends that this supervision be relieved of office clerical work during the work period; that shop staff and other meetings be held at other than the working period and that these supervisors be given the title of foremen rather than leaders.

CHECKING IN AND OUT

Your committee recommends a time clock system for checking men in and out; clock card should show employee's name, occupation and key number. Space should be provided on card for overtime as well as regular time. The

same card should never be used beyond a payroll period and the one week card is preferable.

Clocks should be located convenient to the men's work and no clock should serve more than 125 employees. Unless existing agreements prohibit, clocks should be opened 15 minutes before starting time and closed promptly on whistle; opened promptly at quitting time and closed after all employees have checked out, with an attendant in charge of each clock during checking periods. This clock card should be used as a basis for payroll and checked against workmen's daily time cards.

ROUTING OF LOCOMOTIVE WORK

Experience shows that any system of despatching or scheduling of work through the shop must be predicated upon: (1) A predetermined route; (2) a predetermined time limit.

With the above in view the general outline of a routing system is hereby made. In order to properly carry out the following routing it is necessary to have a competent schedule man, with authority, to follow up the system. The locomotive should be thoroughly inspected prior to entering the shop and the schedule man furnished with a copy of the inspection report from which the shopping schedule is prepared.

Separate forms should be made out by the schedule man covering parts to be repaired in various departments and furnished each foreman. These forms should show the locomotive number, class, date in and date scheduled out of shop and under the heading "Class of Work" the various units of the locomotive, condensed into not exceeding 30 items, to be listed in consecutive order in which the parts of the locomotive are dismantled and erected. Space should be provided opposite each of these items for the date the particular item is to be dismantled or repairs started, and the date the repairs are to be completed and erected. Space also should be provided opposite each of these items, for parts of the locomotive that it is necessary to send to the machine, smith or boiler shops, for the dates these parts should be received in the various shops and the dates they are to be completed. Space should also be provided opposite each item under the heading of "Remarks," for "Cause of delay," if any.

A "Daily Schedule Delay Report" should be furnished by the schedule man to the officers in charge, this form to cover all locomotives in shop on which any part is behind schedule. Opposite the individual engine numbers, space should be provided for the various units of repair, condensed into not exceeding 12 units of repair. Under the heading covering the units of repair space is to be provided for a check mark to show just what items are behind the schedule and are delaying the work, together with the causes of the delays.

A blackboard should be provided in each department, located in a conspicuous place, for the observation of the workmen as well as the foremen. All locomotives in shop requiring work in this department are to be listed on this board. At the top of the board should be shown the units of repair with which the particular department is concerned.

As the various parts of the locomotive reach the department a check mark opposite the locomotive number and under the parts is made. When repairs to these parts are completed and ready for delivery to the erecting shop, another check mark is made. When they are moved from the department, the check marks are erased.

By the use of this board it is possible for any one concerned to readily ascertain in just what department the repairs to the locomotive are being delayed.

SHOP ORDER SYSTEM

Shop or work orders should be issued to obtain the cost of manufacturing parts, repairing machines, cranes, etc., or, when desired, to determine the cost of a specific unit of locomotive repair.

After ascertaining that the necessary raw material is on hand, a shop order number should be assigned and a form issued giving the shop order number, requisition number, date issued, description, drawing number, pattern number and storehouse section. The accounting office should be notified so they may open the account.

The shop order clerk should then issue a card showing departments in which the work is to be performed and then enter in a book with duplicate stubs, kept for the purpose in the foreman's office, the work necessary in that department. After the department completes the work, the foreman will detach and return to the shop order clerk the duplicate slip. By this method it can readily be seen just what department has completed its share of the work.

When all slips have been returned, signifying the completion of the work, the accounting office is notified so it can close the account and compute the cost.

Where there is a sufficient amount of shop order work, it is recommended that a competent man be appointed, with authority, whose duty shall be to see that the work is promptly handled through to completion.

ACCOUNTING

Of the 10 shops visited, eight have in use daily time slips (paper) and two, daily time cards (light cardboard). In all cases except one the daily time cards are made out by the workmen and approved by the foremen. In the one case, the daily time card was also the clock card and the cards were filled out as to hours and distribution by time-keepers.

In all cases, locomotive numbers were shown and the number of hours spent on each, and distribution was drawn off to individual locomotives; arriving at a cost per locomotive as a unit.

The daily time cards in all but two cases provided space for description of work. In three of these cases some description was being shown and in the other seven none; but in no case were descriptions as shown considered specific and complete enough to form a basis of cost. Other than distribution to individual locomotives the only other information shown and the only other distributions made are those necessary to satisfy the requirements of the Interstate Commerce Commission classification of accounts.

RECOMMENDATIONS

It is recommended that one daily time card—size preferably 4 in. x 9¼ in.—of light cardboard paper be used. The card should show name, place, date, key number, occupation, department of shop and rate and should provide sufficient space for locomotive or shop order numbers, etc., description of work and hours worked. Total hours as shown by the daily time card of each workman should be checked with total hours indicated by registerings on his clock card.

After a careful consideration of this subject it is the opinion of the committee that it would be impracticable to endeavor to arrive at the cost of a smaller unit of locomotive repair, from description of work on daily time card, than the locomotive as a whole, except by timing each individual workman, which practice the committee does not believe would be countenanced by the workmen. Therefore, it is suggested that when it becomes necessary or desirable to determine the cost of any specific unit of locomotive repair a shop order or work order be issued, to which all labor performed in connection with this specific unit of repair be charged and in this way determine its actual cost.

REDUCING THE LABOR TURNOVER

Discussion of the Advantages of the Employment Department Idea Applied to the Railroad Shop

BY W. C. NISBET

THE widespread movement toward placing employment matters in the hands of a special department has made less headway among railway shops than in industrial concerns perhaps because the latter by reason of their more centralized authority find it easier to get permission to follow courses of action that are new or unusual. There are, however, so many advantages in a centralized employment department that it is worth the while of mechanical department officers to study the possibilities of the scheme as applied to the railroad shop.

The symptom of trouble which has resulted in so many industrial concerns taking the radical step of turning the whole question of personnel over to a special department, is an abnormally high labor turnover and the attendant loss of production, disorganization and resulting increase of costs. Since Magnus Alexander of the General Electric Company made his extensive and careful investigation into the cost of training a new employee there has been a growing recognition that to lose and replace men on skilled or semi-skilled jobs is an exceedingly heavy and to some extent a preventable expense. Mr. Alexander's estimate was that it cost from $50 to $100 to fill the job of one quitting mechanic with another, due to the loss of production during the interim between men and during the breaking in period. The clerical expense of paying off the leaving man and putting on the new employee was also included. The secretary of Fayette R. Plumb, Inc., machine tool manufacturers, stated in an address, that his company had investigated this expense for machinists and found it to be not less than $100 per change.

Such figures are, of course, merely estimates, and the cost will vary within wide limits, depending on many circumstances. A yard laborer who quits may perhaps be replaced with another who at once completely fills the job of his predecessor, but the loss due to changing will vary from this instance to another extreme where the quitting of a valve setter, an air brake man or other skilled hand may slow up the entire shop production before a competent substitute is found and broken in to maintain the pace of the first man.

It is perfectly evident that whether the average cost be $10 or $200 per man quitting, it would be decidedly advantageous from every standpoint to reduce the labor turnover. The question is, how can this turnover be reduced?

One way of attacking any difficult problem is to assign a man to give it constant attention and supervision and thus escape the common fault that what's every one's business is nobody's business.

WHY AN EMPLOYMENT SUPERVISOR?

Assuming that an employment supervisor has been selected, to expect results from such an individual it will be necessary not only to make him responsible for reducing the turnover but also to give him authority to control at least a part of the causes which affect the coming and going of employees. To do this it has been customary to place what is known as hiring and firing in the hands of the employment supervisor, with the belief that better results will thus be gained than by leaving these important functions subject to the personal inclinations of 40 or 50 different foremen. The reasons for taking these duties from the foremen and giving them to the employment supervisor are many. Some of them are as follows:

(1)—Foremen lose much valuable time interviewing applicants for work. It is not infrequent for a foreman with such important responsibilities as supervision of an erecting gang or a rod and motion gang to be called to the office three or four times a day to see different individuals who apply for jobs. It is easy for a foreman thus to lose from a half hour to two hours daily, interviewing applicants, and hence impairing the effectiveness of his supervision.

(2)—All too frequently foremen hire or fire from prejudice, favoritism or on account of religious, lodge or other affiliations. Injustice in such cases is expensive, because the resentment aroused may be passed from one individual to another, until the shop acquires a bad reputation. Furthermore, it is unfortunately not uncommon that when a man desires to quit and applies to the shop office for his time, he is kept hanging around for hours before the foreman appears to give him his clearance. He may have the best reason in the world for leaving; in any case, what kind of a word is he likely to pass around as to the character of that particular shop? A centralized employment department handles such cases promptly and with a settled policy to remain friends if at all possible.

The good will of a business is recognized as a valuable asset. Is not the good will that some shops enjoy through friendly and just dealing an equally valuable asset?

(3)—Foremen often "give a man his time" because there is no more work for him in that particular department, when in another department the man might be needed and fit in exactly. The employment department offers an agency for conveniently effecting such transfers.

(4)—Most foremen have not the aptitude, time or opportunity for hunting up likely candidates, filling out their applications and maintaining records of workmen. As to the latter it is often found that comprehensive records showing the education, training and experience of those at work is a prolific source of information leading to transfers of laborers and other non-skilled men to better paid positions.

(5)—It is important to know why men quit, what departments they leave in largest numbers, what types or trades are most affected, etc. From such figures intelligent conclusions may replace guesses and proper steps be taken to cure or remedy such evils as become evident.

(6)—As we come to recognize that a competent workman is potentially of far greater value than one who is incompetent, it becomes increasingly important to take every means to select the more competent individuals. It is far easier to appoint one person as an employment supervisor and train him to make intelligent selection of applicants than to trust this most important function to scores of foremen each of varying capacity, all of whom are engrossed with a multitude of other duties.

RELATION OF EMPLOYMENT SUPERVISOR TO FOREMEN

In some plants using an employment supervisor the foremen have been notified that they might on cause dismiss a workman from their department but not from the plant. A man thus dismissed is turned back to the employment department for disposition. He may be discharged, but if let off for lack of work or dismissed by the foreman for trifling cause he may be transferred to another department with the proper kind of plain talk as to the conduct which will be expected of him in the future. Other plants allow the foremen to fire men, but require a written notice to the employ-

ment department three or more days before the dismissal is effected. This prevents hasty action and discourages the foreman from acting without good cause.

In hiring men the employment supervisor usually receives a form from the foreman stating that he is in need of a certain number of men, as radial drill hands, erecting gang men, laborers, etc., as the case may be. The supervisor selects from applicants, in person, on file or by advertising for the number required, but they are not actually hired until the foreman accepts them. He may reject them if he wishes, though in practice the employment supervisor should and generally does work in such close touch with the foremen that he will know the type the latter desires and will not refer men to the foremen unless they are likely to be acceptable.

If it is conceded that the man problem is in a way the largest single problem in industry, it appears only reasonable to spend considerable time and money in studying it and endeavoring to improve the present situation. For practically every machine there is a man who controls or at least affects the quality and quantity of output. His aptitude, training, experience, energy, regularity of attendance, even his frame of mind, are all variables which in some degree might be improved or corrected if proper provision were made to that end.

For a long time rigid specifications and careful inspections have been common in buying materials and machines. On the other hand, many of our workmen have been hired almost at a glance, without even the most elementary scrutinizing of credentials, experience or fitness. Does this not have a bearing on the fearful procession of incompetents and misplaced individuals who are today passing through our shops?

Of course, the answer will be made that labor shortage, high wages in munition plants, army drafts and similar causes have been the reason for high labor turnover and the placing of incompetents. Naturally these causes have had a great effect, but in many plants it had been recognized even before the war that the former methods of hiring and firing and handling workmen might be improved upon.

DUTIES OF THE EMPLOYMENT DEPARTMENT

Aside from hiring and firing there are many other duties that can be performed by an employment department to better advantage than by the already overburdened foremen. Some of these are to arrange for the physical examination, maintain proper individual records, investigate references and look into absenteeism and tardiness. The timekeeper's department no doubt has a record of the latter, but they are occupied with their regular duties and do not usually go into causes or act to prevent recurrence. The foreman generally knows of the cases, and is sorely tried by the absence of important workers, but his common remedy of angrily "bawling out" the offenders, or perhaps merely a sour look when men are scarce, seldom goes to the root of the matter. Besides, a foreman might well be freed from this task to have more time for others of more importance, such as planning his work, arranging for material, noting quantity and quality of production, instructing the beginners and in general keeping things in motion.

The employment department can listen to complaints. Some men satisfy themselves simply by airing their troubles. This may keep them away from the grievance committee.

Modern business is a cold proposition at best, and it is too frequently forgotten that the workman has human problems of his own and often has a natural inclination to ask advice at the shop where he earns his living and spends most of his waking hours. The foreman of today is forced by press of business to discourage this, and even if he does not there is little opportunity to tell domestic troubles beside a steam hammer, a forging machine or an air riveter.

The person selected for the position of employment supervisor should have rather more of the milk of human kindness in his makeup than is common, and should also be able to speak some of the more common foreign languages used by the workers. In a case where many of the workers were Mexicans an employment supervisor was selected who had lived in Mexico and who had considerable sympathy as well as understanding for the workers. The improvement in turnover was immediate, due as far as could be seen to the substitution of a little humanity for the former cold business dealing with difficulties unexplained and misunderstood.

We all know the foreigner who smiles and says "Yes, yes," but understands nothing and quits next week on account of some imaginary trouble. Doubtless the ultimate remedy is to teach these foreigners English, but meanwhile to do business with them this month, and today it is worth while to have one who can speak their language provided they are employed in considerable numbers.

The employment department can arrange for special training. In some shops to the employment supervisor has been delegated the duty of establishing schools to teach the inexperienced how to operate certain machines. In munition plants barbers, waiters, etc., have quickly been made into lathe hands who often became large producers. Railway shops seldom have such continuous production on any one machine, but the same method of intensive teaching could be followed on many kinds of work.

Some employment supervisors have been assigned the job of investigating the effect of hours of labor on fatigue for all the principal shop jobs. The subject of fatigue in industry is dismissed as "high brow" in most circles, but we cannot escape the fact that fixed rest periods have been found to have increased production in certain kinds of work; also that if we ourselves had to wheel pig iron all day we would soon discover that there was a decided relation between hours of labor and fatigue. We should probably declare in favor of the one-hour day. On the other hand, there are many shop jobs in which it would be no physical hardship to work 12 hours.

It is worth while to determine the facts as to the jobs between the very easy and the very hard and standardize rest periods accordingly. It is not sufficient to leave it to piece workers to rest as often as necessary. The lazy are inclined to rest all too frequently if their rate or the manner of checking production will allow it, and the ambitious but deluded will keep going even on heavy work when a five-minute-per-hour rest would produce a greater output.

DESIRABLE QUALITIES OF AN EMPLOYMENT SUPERVISOR

The element most essential in an employment supervisor is probably tact, as he must maintain co-operation between the men, the foremen and the management; next he should be of a friendly, sympathetic nature to develop similar feelings in the men toward the management and finally by natural aptitude, education and training he should develop the ability to judge men.

He should be a first-class man with a high conception of his work, for it is within the possibilities of his job to be of great value to his employers and also necessarily to help the men to improve themselves mentally, physically and financially.

It goes without saying that he should be a man with extensive mechanical and railroad experience in order to recognize the elements of the various jobs which he is called upon to fill so that when interviewing applicants he can instinctively recognize the fitness of the individual for some one of the half-dozen openings he may have at the moment.

SELECTION OF EMPLOYEES

The employment supervisor will develop a certain amount of ability to recognize competent workmen, he will even

sooner develop ability to recognize and avoid types harmful in a shop, such as the belligerent ones, the agitators, the intemperate, the drug users, etc. Observation and conversation are very potent in discovering the traits and tendencies of applicants.

Letters of recommendation are seldom valuable but the occasional tip of value makes it worth while to utilize them. Investigation before hiring frequently develops that a man skilled in a certain trade may not be able to follow it in the particular assignment at hand. For example, a carpenter was hired for shipyard work and was assigned to putting up overhead timbers. It happened he was a skilled workman, but had a physical affection such that his back could not stand the overhead work. He asked for another assignment, but was told "that or nothing," and had to quit the yard, though his trade skill was needed in several places in that very yard. The loss of such a man might be avoided by preliminary investigation and proper assignment.

Psychologists like Walter Dill Scott and William Kemble have developed methods of testing applicants, some of which are extremely valuable, and can be applied to shop workers to good effect. Many successful concerns are adopting some part or adaptation of such methods.

There is a deep-seated feeling among many mechanical men that such methods are impractical and, in fact, they often may be. The term "psychological tests" is high sounding, no doubt, but at bottom what is meant is merely a test frequently using the tools of a given trade to allow the applicant to show he can do what is expected of him.

A test for a laborer would be chiefly as to his strength measured on a testing machine, and while strength isn't everything with a laborer, other things being equal, we desire the strong rather than the weak.

As to testing a lathe hand we know that if we led the applicant to a lathe, gave him the steel and a blue print of a knuckle pin and told him to turn it up we could readily tell whether or not he is the mechanic we want. This would be a practical test very desirable where feasible but probably not possible of application if we were selecting one lathe hand from several applicants. Almost the same results would be secured by handing the applicant a cut of a lathe and a print of the same knuckle pin and letting him tell the examiner how he would proceed with the job. The same idea can be developed indefinitely.

As to the selection of desirable employees in general it is worth remembering that while experience and ability are of prime importance, yet we may lose the advantage of his skill if a man is irregular in attendance, careless, lazy or belligerent. These traits can often be detected in advance by a skilful employment supervisor experienced in watching for just such traits. What we hope to avoid by the centralized employment department is by more careful scrutiny to avoid hiring the trouble makers, the incompetent and the otherwise undesirable who would soon quit or have to be let out. We wish to increase the number of steady workers, the men with constantly growing skill.

WHY SOME SHOPS HOLD THEIR MEN

The J. B. Stetson Company, according to an address by one of their officers, has the creditable record that over 69 per cent of their employees have been with the company over five years. Such records, while by no means common, are not the sole possession of this company.

Wages have probably the largest bearing of any one feature, but there are many other elements which hold men to the old job. Where wages are not a disturbing element perhaps the next most important feature is the treatment accorded the men by foremen and others in authority. Harsh, arbitrary or unjust treatment is very effective in driving men away, and, conversely, a friendly, human attitude and the occasional exhibition of sympathy helps to cement the workers to their jobs. Harsh treatment by those in high positions generally is reflected in the way the foremen treat the workmen.

The expectation of promotion or of periodical wage increase, provided such expectations are ultimately realized, are also helpful in holding workmen.

Good living accommodations for families within convenient access of the shop, allow the retention of married men living at home who naturally are more stable than boarders.

Lunch rooms in the shop or adjacent thereto are now common in industrial plants, for it is evident that whether the men go home, resulting in a hurried walk, or whether they bring their lunch and eat cold food, indigestion is encouraged. It has been found that where a committee of the men handles the lunch room there is less complaint than where the company manages it.

The management of certain plant activities by workmen's committees can be extended to good advantage. In some plants a loan society to beat the loan sharks is run by the men with the co-operation of the management. The itch to run something on the part of certain individuals among the men can thus be gratified and their activities on the grievance committee partly or wholly avoided.

Educational classes for the men appeal to those who are ambitious and help to make men more valuable. English classes in particular are helpful, as they at once make it easier for the foremen to communicate orders and instructions to their men. The intensive method of teaching English to the aliens in the draft army might be copied in this connection.

Parking space for bicycles, motorcycles and autos is appreciated by the considerable number using such vehicles.

As an indication of the extent to which some firms operating strictly for profit have gone to get the most from their employees by welfare methods, Montgomery Ward & Company is reported by the Department of Labor to have made tests and found that the low periods of production are at 10 o'clock in the morning and 3 o'clock in the afternoon, and to keep up the workers' energy, hot malted milk is passed around to all at these hours, free of cost. This may sound like a joke when we apply the idea to such husky workers as Polish riveters, forge hands, etc., yet almost any

ORGANIZATION OF A SHIPYARD SERVICE DEPARTMENT

Manager of the Service Department.

A—Employment division.
- Soliciting and advertising campaign for employees.
- Selection of employees.
- Records of employees.
- Adjusting grievances.
- Transfer to other work.
- Investigation of discharge and voluntary leaving.

B—Health and safety division.
- Physical examination of applicant for employment.
- Treatment of accident cases.
- Free medical advice to employees.
- First aid classes.
- Statistics of accidents and time lost.
- "Safety First" campaign.

C—Welfare work division.
- Restaurant.
- Bulletin boards and special reports.
- Employees' magazine.
- Clubhouse and reading room.
- Recreation and athletics.
- Naturalization assistance.

D—Educational division.
- Apprentices.
- Evening classes.
- Training new employees.
- Special training for certain important trades.
- Co-operation with state and federal agencies.

E—Housing division.
- Construction of new buildings.
- Finding and listing rooms and houses for rent.
- Information bureau.
- Co-operation with board of trade to prevent excessive charges.

such means of keeping up the production of day workers would pay far more than the cost.

The Curtis Publishing Company provides a farm home which employees call their country club and use as such.

The extensive labor department organizations of several of the shipyards is given in the table to show the scope of their activities in the selection and effort to hold employees.

RESULTS OBTAINED BY EMPLOYMENT DEPARTMENTS

Is the outcome of the effort and expense of developing an organization to work on the employment problem worth while?

To help answer this natural and reasonable question there are given below the comparative figures of several companies which have been working with an employment department to improve their turnover and using some or all of the methods mentioned herein, to secure and hold better employees.

The figures are taken from the Annals of the American Academy of Political and Social Science and may be considered as reasonably correct in most cases.

The Saxon Motor Car Company reduced labor turnover 140 per cent in one year. The Semet Solvay Company reduced labor turnover from 120 per cent to 29 per cent. In 1912 the labor turnover of the Plympton Press was 186 per cent; in 1916 it was 13 per cent. The Ford Motor Company has reduced labor turnover from 400 per cent to 23 per cent. The Dennison Manufacturing Company has reduced labor turnover from 68 per cent to 28 per cent.

The Gas Welding of Thin Plates

The Requirements of Thin Work With and Without Use of Rods; The Behavior of Various Metals

BY J. F. SPRINGER*

II.

ONE of the principal problems connected with the welding of thin plates with the oxy-actylene torch is the control of the temperature to which the plates are brought. There is frequently trouble in preventing overheating of the work, causing part of the weld to melt away and drop out.

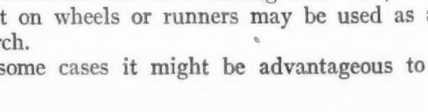
Control of temperature may at times be secured by modifying the angle that the axis of the jet makes with the surface of the seam. When the flame strikes perpendicularly it covers a smaller surface than when it strikes at a sharply acute angle. The same amount of heat is involved in both cases, but the higher temperature will be associated with the greater degree of concentration. For ordinary work, an angle of 45 deg. will be found about right, but in copper welding where there may be trouble in getting enough heat the torch may be used with a greater angle, even up to 90 deg. Aluminum sheets, on the other hand, may need a fairly sharp angle such as 20 or 30 deg. It should be remembered in using an acute angle, however, that the flame will tend to cover a greater part of the seam and will in consequence pre-heat the seam ahead of the zone in which the welding is being done. While the effective temperature will thus be reduced, the time required to secure the molten condition may not be reduced as much as one might expect.

Another method of reducing the effective temperature is to conduct a portion of the heat away from the work. This may be especially useful in welding very thin sheets in joints of the folded type where there may be four thicknesses of very thin metal through which the welding temperature must penetrate without melting the bottom sheet.

There are two ways of accomplishing this purpose. First, the work beneath the seam may be brought into close contact with comparatively cool metal. Thus, the work may be laid upon or even forced down upon a metal slab, which absorbs and conducts away a portion of the heat. The best ordinary metal for this purpose is copper, steel and iron being considerably less effective. The second method is to set a flat tube into the table top so that the work may be brought in contact with its upper surface. The ends of the tube should extend beyond the ends of the table and be of circular section for connection to water supply and discharge pipes. The metal in the tube alone may be sufficient for much of the work, but by turning on the water a further cooling effect is available. Flat under surfaces should be presented by the joints and effective contact with the cooling surface may require the use of clamps. The clamps may also be useful in holding the work against the deformation from expansion of the metal in the seam.

To intensify the heat presents exactly the reverse problem. Sometimes, the character of the metal is such that difficulty is experienced in getting the temperature up to the proper point. Such a condition might well arise with copper and even with metals whose heat conductivity is much less. The work may be steel plates of considerable thickness to be welded in a butt joint with no groove and without the use of a welding rod. The torch is thus called on to pour in heat rapidly enough to raise a considerable thickness of metal to the welding temperature. This situation may be more or less completely provided for (1) by the use of an air space beneath the seam, or (2) by the employment of a solid non-conductor of heat. The air space is provided by a groove or channel in the surface of the table. In the other case the groove may be filled with asbestos, mica or magnesia. If an open groove is used it should not be so wide that the edges of the work will be inadequately supported. The advantage of the solid conductor is that it provides complete support, although the air is probably the better non-conductor.

The greatest difficulties connected with the welding of thin plates are due to unsteadiness of the welder's hands, which results in irregularity in the speed at which the torch advances and in variations in the height of the torch above the work. To overcome these difficulties practice is invaluable, but the workman may find it of considerable assistance in keeping the torch at a uniform height to make use of a horizontal bar as a sliding rest. Or, if preferred, a bracket on wheels or runners may be used as a holder for the torch.



Cross Section of Cooling Tube in the Top of Welding Bed

In some cases it might be advantageous to extend this

*Author of the handbook, "Oxy-Acetylene Torch Practice."

idea a step further. The movement of the work beneath a stationary torch was a fundamental part of the design of the welding machines seen by the writer at the Edison Storage Battery Company's plant some years ago. The seam to be welded was held in a clamp so shaped as to provide access for the torch tip and the welding was done by moving the work along under a stationary torch. This method is especially adapted to cases where a welding rod is not used, the workman thus having both hands available for controlling the work.

WELDING WITHOUT ROD

Welding without the use of a rod is both practicable and advantageous. The object of using the rod is to provide new material to fill the groove and sometimes to increase the thickness of metal at the joint. Both results may be secured without the rod. The purpose of a groove is to make the full thickness of the joint accessible to the torch flame. Several types of joints have already been referred to in which heat penetration is secured by conduction and no groove is provided. Even if extra thickness at the joint is desired in order to offset the loss of strength through overheating, the welding rod may still be dispensed with as suitable ridges may be provided before the welding begins, the melting down of which supplies the extra metal. Where grooves are used, it is often quite possible to form the edges so as to furnish the extra metal required.

There are two principal advantages in omitting the rod and substituting formed edges. (1) The workman has his left hand free, and (2) a uniform amount of new material is supplied all along the joint. On the other hand, there is the disadvantage that the action of the high temperature makes ordinary steel rather brittle and wanting in ductility. By the use of a very pure iron rod, this condition may be remedied. There will, nevertheless, be many cases where the use of a rod will be, at best, of doubtful value and it may well be eliminated.

The edges may be prepared by bending and forming or by upsetting and forming. Where a groove is to be provided, it will, as a rule, hardly be necessary on thin work to bevel at so flat an angle as 45 deg., the standard for general work, the object being to insure a degree of heat penetration sufficient to insure a complete weld. A bevel of 60 deg. or even 80 deg. with the horizontal may be adequate.

MAKING THE WELDS

In welding the simple butt joint where edge is set against edge, particular attention is to be centered upon the necessity of making the high temperature penetrate all the way if the torch is to operate from the one side only, half way or more if the torch is to operate on the work after it has been turned over. If these directions as to penetration are not fully complied with, a defective weld will result. Where the plates are very thin, and too much heat comes from the tip of the torch, the axis of the flame may be directed at a sharp angle to the joint or some type of cooling surface may be used beneath the seam. If necessary, the torch tip may be made to oscillate from side to side across the line of the joint by rotating the tip as it is advanced.

The Edison joint is treated somewhat differently. No oscillation ordinarily will be necessary. The flame is steadily advanced along the line of the joint and is not diverted to one side or the other. The object is simply to melt the two edges and permit the metal to flow together. At times some adjustment of the pressures of the gases may be needed to avoid blowing the molten metal off the edges. The joint is a very simple one to weld, as is well proved by the fact that it has been found practicable to make it with power-driven machines.

In the modified Edison joint where the flanged edges are not deep, more care on the welder's part is needed. The welding may be done as in the original type of joint, or the method employed with the plain butt joint may be used.

In welding the modified plain lap joint where the edges are over lapped and the welding is done by melting off the corners on both sides of the work, and causing them to unite with the adjoining sheets, the torch may be held so that the force of the jet will carry the metal to position. In doing this, however, one must be careful to make sure that the sharp corner into which this metal goes has already been heated. There is probably no one fault more common among welders than that of putting molten metal onto metal not sufficiently heated.

In the type of butt joint where a strip is inserted between the two edges, the work may be handled after the manner used with the plain butt joint. If so, then make sure that the inner white flame is large enough to supply heat on both sides of the projecting strip at one moment. The strip and the edges of the plates are to be melted together.

The folded joint calls for an underlying cooling strip either of simple solid material or a flat tube through which water is kept circulating. With some work it may be necessary that the cooling strip be grooved out on top in order to hug the work along each side of the broad joint.

BEHAVIOR OF VARIOUS METALS

In welding metal plates, it is desirable that the welder be informed with some definiteness and completeness how various commercial metals behave when subjected to the oxy-acetylene torch. It is not only the heat of the flame that acts upon the metal sheets but the active chemical substances in the flame. The gases in the flame are distributed substantially as follows. The acetylene breaks up as it emerges from the torch into hydrogen and gaseous carbon. As far as the brilliant white flame extends there is incandescent carbon, which accounts for the brilliancy of this part of the flame. In short, all through the inner white flame, we have uncombined hydrogen, oxygen and carbon. At the end of the white flame, the carbon burns to carbon monoxide (CO), but the relative amounts of acetylene—the source of the carbon—and oxygen are regulated so that there is not enough oxygen for the conversion of the carbon to carbon dioxide (CO_2). There are two combustible gases beyond the white flame. These are hydrogen and carbon monoxide. Both require oxygen; this they get principally from the surrounding atmosphere with probably a small amount of excess oxygen from the torch.

The excessive temperature of the oxy-acetylene flame, far beyond that of the oxy-hydrogen flame, seems to be due to two things: (1) the heat generated by the decomposition, or explosion, of the acetylene and (2) the burning of the gaseous carbon to carbon monoxide. The two sources of heat combined produce the "hot spot" just beyond the end of the small white flame.

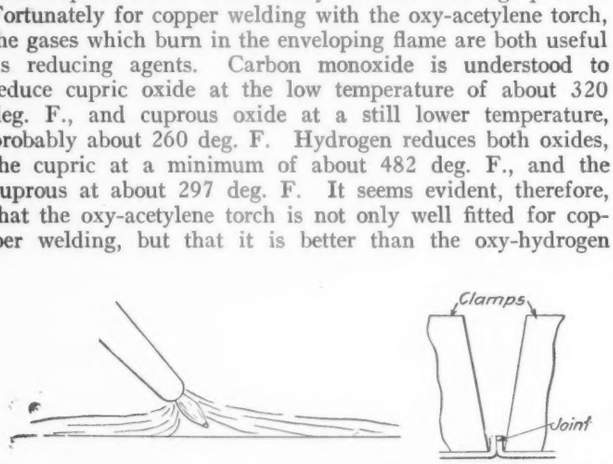
A little consideration will show that the possibilities of chemical action are very considerable and in dealing with thin plates this may become a very important matter. If highly heated steel is brought within the white flame it encounters hydrogen, oxygen and gaseous carbon. The first will probably do no harm but both of the others have a damaging effect. Pure oxygen is, in fact, the cutting agent so successfully used in the cutting of hot steel, while carbon acts as a carbonizing—hardening—agent from, say, 1,500 deg. F. up. The lesson for the welder is that any carelessness in handling the torch that results in playing the white flame directly upon hot steel is very apt to damage the material.

The exterior enveloping flame, large in size and moderate in temperature, is beneficial in its action. Consisting as it does of gases avidly seeking oxygen, this flame acts as a protector against the activity of the oxygen of the air. The

enveloping flame of the oxy-acetylene torch contains carbon monoxide and hydrogen, both actively uniting with oxygen, and consequently both protectors against it.

The lesson for the welder, especially when the condition and appearance of the work after welding is of importance, is to utilize this flame as far as possible as a protector of the work against oxidation. This lesson applies quite generally to commercial metals other than steel. When at a high temperature nickel is readily oxidized by the atmosphere and copper is probably the most dangerously affected of all. The prevention of the activity of oxygen is possibly the greatest difficulty in the commercial welding of copper.*

Two oxides—cuprous oxide (Cu_2O) and cupric oxide (CuO)—are formed by the oxidation of copper. Oxidation begins when copper is heated in the presence of air to only 365 deg. F. As the heating continues, so does the oxidation. The coloration of the metal varies from rose to brass, to blue green and then to a dark shade. A dark scale forms at a red heat, about 1,100 deg. F., which consists on the outside of the cupric oxide and on the inside of cuprous. The cupric oxide forms early in the heating process. Fortunately for copper welding with the oxy-acetylene torch, the gases which burn in the enveloping flame are both useful as reducing agents. Carbon monoxide is understood to reduce cupric oxide at the low temperature of about 320 deg. F., and cuprous oxide at a still lower temperature, probably about 260 deg. F. Hydrogen reduces both oxides, the cupric at a minimum of about 482 deg. F., and the cuprous at about 297 deg. F. It seems evident, therefore, that the oxy-acetylene torch is not only well fitted for copper welding, but that it is better than the oxy-hydrogen



Arrangement of Clamps on Edison Joint which Use the Outer Flame as a Protection against Oxidation

instrument, the minimum reduction temperatures with carbon monoxide being less than with hydrogen.

It is often possible to provide facilities by which a part of the outer flame may be utilized as a covering of the seam ahead of the point of welding and another part as a covering at the rear. This is what was done in the case of the machine welder used by the Edison Storage Battery Company in welding the longitudinal seam on nickel-plated steel containers. The clamping device which held the work was of such a character that it provided a deep canyon with the seam at the bottom, the canyon being large enough to admit the torch tip and the flame. With this arrangement, the enveloping flame naturally divided itself into two streamers, one lying on the joint ahead of the torch tip and the other on the joint behind the torch tip. The air was thus shut off from the metal all along the joint, until it had cooled down somewhat in the lower temperature of the enveloping flame of the torch. The forward streamre performed a good service by pre-heating the joint before it reached the welding flame, thus lessening the work which that flame had to do.

In all torches an excess of oxygen must be furnished beyond what is theoretically necessary. For one cubic foot of acetylene, only one cubic foot of oxygen is actually used in effecting the chemical combination of carbon monoxide. The excess may run up as high as 35 to 40 per cent, but this indicates a poor torch and oxygen is being wasted. Anything less than 25 per cent, however, may be regarded as reasonable. What becomes of this extra oxygen? Doubtless, some of it after passing through the white flame and past the "hot spot" combines with hydrogen and carbon monoxide in the outer flame. This should be the case when the torch is burning but is not in use. It would seem that this excess oxygen might make more or less trouble when the work is being operated upon. With steel and iron it is probable that the matter is not sufficiently serious to cause much trouble. But with copper and perhaps some other metals, it may be necessary to take measures to overcome the difficulty. One way of doing this is to convert the neutral welding flame into a carbonizing flame.

When the oxy-acetylene inner flame is a brilliant white, is sharply outlined, and consists of a single cone or pencil, it is said to be neutral—that is, there is a balanced condition, and the acetylene is being burnt with the least amount of oxygen possible with that torch. This is the proper condition for welding in general and especially for thin sheets likely to be harmed by either oxygen or carbon. If the oxygen cock is opened wider or the acetylene cock further closed, the neutral flame will be changed to an oxidizing flame. The brilliancy of the cone will be lost and the cone itself will shrink. If, on the contrary, the neutral condition be changed by partially closing the oxygen cock or opening the acetylene cock wider, then a carbonizing flame will result. This means that not enough oxygen is coming through the tip to burn the carbon of the acetylene to carbon monoxide. Consequently, there will be free carbon beyond the usual point. The carbonizing flame may be recognized by noting that the cone is double. For copper plates and for brass plates made from an alloy high in copper, the carbonizing inner flame may be used to make sure that there is no free oxygen in the outer flame.

The non-neutral conditions will occur accidentally, even after a torch has been adjusted to an exact neutral condition. This means that the welder must always be on the alert to correct the adjustment. The neutral flame is so distinct in its appearance that the condition of the flame is very readily determined. The welder operating on thin plates should be eternally on the watch for a change in his flame. Such a change may come about through variations in the pressure back of one of the gases.

Lead may be welded with the oxy-acetylene torch. In the shape of plates, however, the metal requires strict attention because of its low melting point, 621 deg. F. Not only is the melting point low, but the specific heat is also low. This combination means that it requires comparatively a very small amount of heat to attain the melting point. The workman needs to do his work steadily and quickly or else to provide for reduction in the amount or degree of heat. The amount of heat may be cut down by using less pressures or a smaller torch. The temperature may, in effect, be reduced by methods already described. That is, the angle at which the tip is directed onto the work may be flattened, or provisions for cooling may be used. Lead has the advantage of low heat conductivity which permits close localization of the heat in welding.

Nickel behaves a good deal like pure iron. When more than a plating of the metal has to be taken into account, the welding action does not take place so well by merely melting the edges, pressure being needed to assist the metal to unite. The union may then be effected at a temperature below the melting point without the use of a welding rod or a groove at the joint. The welding is, in fact, not a true autogenous process, but from a practical point of view the work may be done advantageously with the aid of the oxy-acetylene torch. The necessary pressure may be applied with a hammer or otherwise.

Tin has a low melting point (449 deg. F.) and a low specific heat. Accordingly, the welder of block tin plates

*For other information on copper welding, see an article by the same author in the *Railway Age Gazette, Mechanical Edition*, for July, 1915, page 367.

must act quickly and steadily. Similar remarks apply to zinc with its melting point at 796 deg. F., and a moderate specific heat. The readiness with which tin conducts heat is fairly slow, while the conductivity of zinc is quite slow. Consequently, with the former a fair localization should be possible and with the latter quite a good one.

The localization of heat may, as already indicated, be promoted by the use of a non-conductor of heat (such as air, asbestos or magnesia) in a groove on the work table underneath the seam. In addition to this, asbestos pasteboard or sheets may be laid on top of the work and brought up close to the seam on both sides of the joint.

AUTOGENOUS WELDING AT ALBUQUERQUE

Burned or Cracked Sheets and Tubes Repaired by Gas or Electric Welding; Welding of Flue Beads

BY H. LOUIS HAHN

THE problem of efficiency and economically welding locomotive parts has resulted in the development of some interesting methods in the Albuquerque Shops of the Santa Fe System.

The method of applying two new side sheets and a three-quarter door sheet is shown in Fig. 1. The back end of the side sheet and each side of the door sheet are turned at an angle of 45 degrees, this slight turn being made cold in the clamps, thus eliminating the heating and flanging of the side flanges of the door sheet at the flange fire. The door hole opening is flanged at the fire and the flat sheet then sent to the fitting up floor, the sheets fitted and chipped to a 3/16-in. bevel opening as shown and the welding completed by using a gas torch. This makes a very neat job.

Fig. 2 shows a method of preparing side sheets along a

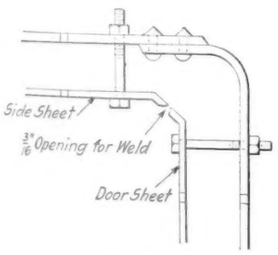


Fig. 1

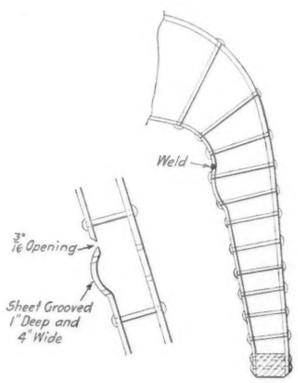


Fig. 2

horizontal seam to compensate for the contraction of cooling welds. The side sheets are laid out, sheared, punched and chipped in the usual manner and are then sent to the blacksmith shop, where a large steam hammer, fitted with a concave die and swedge to suit, is used to put the roll in the sheet as shown. The roll is put in the sheet for the entire length, except at the ends just below top edge to be welded. The ends at the door sheet and flue sheet are left flat for a distance of four inches.

In some cases staybolts are applied before welding the horizontal seam, in others the staybolts and rivets are applied before welding, but in most cases the sheets are applied with a temporary fitting using bolts. The welding is done with a gas torch. No difficulty is experienced from contraction of cooling welds as the roll in the sheet relieves the strains. The same method is also used for the horizontal seams of the three-quarter door sheet when the seam is a sufficient distance above the firedoor opening.

Fig. 3 shows the method of fitting a full or a three-quarter door sheet when old side sheets or the crown sheet are not removed. The portion of the old side sheet containing rivet holes is removed as shown at *B* and a 45-deg. bevel chipped on the sheet. The door sheet is fitted in the regular manner, allowing the surplus flange to lap over the side sheets. The flange is then scribed or marked even with the edge of the side sheet, the door sheet removed and the surplus flange chipped or punched off. The door sheet is then reapplied

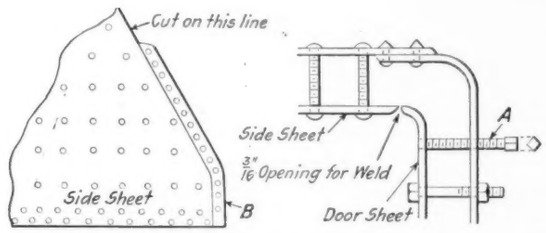


Fig. 3—Welding New Door Sheet to Old Side and Crown Sheets

and the edge of the flange set out 3/8 in. all around to make it flush with the side sheet. The edge of the flange of the door sheet is then chipped bevel for welding. Enough staybolts *A* are applied in holes in the outside sheet and screwed against the door sheet to push the latter into position to allow a 3/16-in. opening for welding. Bolts are applied between the staybolts, and loosened as welding progresses.

Fig. 4 shows the method of repairing cracks in side sheets

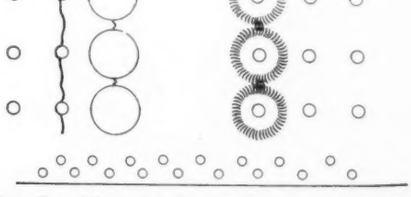


Fig. 4—Repairing Cracks in Door or Side Sheets

and door sheets where there are a small number of cracks and removal of the sheet is not justified.

The staybolts are removed and 3 1/8-in. sunflower plugs applied in the sheet as shown. The crack between the plugs is then chipped out to a 90-deg. opening and a space 1/2 in. wide, 1/4 in. on the plug and 1/4 in. on the sheet is thoroughly worked with a roughing tool in an air chipping hammer to remove all scale. The cracks and roughed edges of the plugs and sheet are then electric welded, using a metallic electrode.

After the patches, sheets and rivets are applied the calking

edges of the side, door and flue sheets are welded to the mudring for a distance of eight inches each way from the corner, using an electric metal electrode process.

On old fireboxes, where it is desired to run a defective riveted seam until the regular shopping period, the seam is chipped clean, and the roughing tool used on rivet heads, the seam between the heads, the calking edge and on the sheet for a distance of ½ in. beyond the calking edge. The entire surface is cleaned and roughed and then covered with a layer of added metal about 2½ in. wide, using electric metal electrode process.

Cracks in door hole knuckles are V'd out and electric welded when they are less than two inches in length. For a door hole knuckle having a number of cracks which are over two inches in length a door collar is applied and gas welded. When welding cracks in fireboxes by the electric arc method a live steam line is always inserted in the water space at the mudring to bring the sheets to a good warm temperature before welding, thus prolonging the life of the weld in service.

All firebox door hole flanges are lapped over the backhead door hole flanges the regulation distance for applying rivets, the flanges fitted tight, and after the edges have been beveled as for calking the calking edge is welded to the backhead sheet, no rivets being applied. Should this weld leak at an outside division point where no welding facilities are available holes may be drilled, patchbolts applied and the door hole flange chipped and calked in the regular manner.

Flue beads are welded to the back flue sheet. The flues are applied in the regular manner and the engine taken out

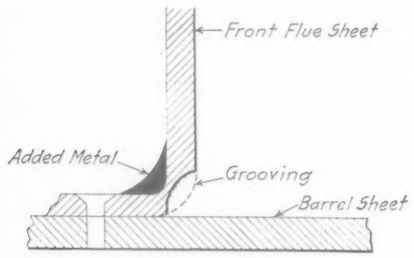


Fig. 5—Repairing Grooved Tube Sheet Knuckle

on its break-in trip in order to boil and burn off all oil and grease on and under the beads, after which the beads are sandblasted and welded to the back flue sheet.

In order to educate electric welders to become flue welders the writer prepares old tube sheets removed from fireboxes by rolling old tube ends about three inches or four inches long in all the holes, beading them in the usual manner. The sheet is then conveniently placed for the welder to practice on and after welding about one thousand of these experimental tube ends he is ready to go in a firebox and start welding regular tube beads.

No patches are applied to the firebox side or door sheets except slip patches at mudring corners, which are gas welded. Crown sheets are patched when they become defective under the T-bars. After the patch on the crown sheet is fitted up ready to weld it is stayed in position by the use of "strongbacks" made of two pieces of ¾-in. by 5-in. flat iron riveted together with a space between them to insert fitting up bolts. These are placed on the top of the crown sheet edgeways and are used to line up the new patch and the old sheet. They are kept in position until after the welding of the patch seam is completed. The gas torch is used on this job.

Grooving of the knuckles of front tube sheets adjacent to the barrel sheets is a common defect and is remedied as shown in Fig. 5. The flange rivets adjacent to the grooved portion of the tube sheet are removed and the fire side of the knuckle of the flange is built up until the thickness equals the original thickness of the sheet, using a gas torch. The flange is then heated, fitted tight and rivets reapplied. This method avoids the removal of tube sheets which otherwise would have to be renewed.

Fig. 6 at *A* shows a defective top tube sheet with the knuckles removed. The sheet is cut across in a straight line through the center of the horizontal bridges in the fourth row from the top. A new patch is flanged and fitted in

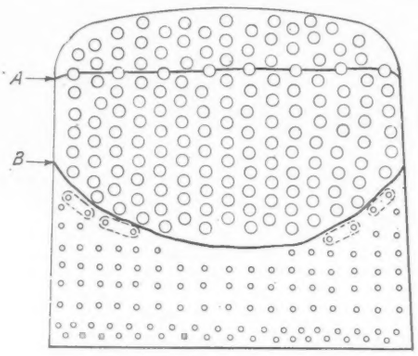


Fig. 6—Patching of Tube Sheets

position and a 3/16-in. opening is beveled and gas welded. After the welding is completed the tube holes adjacent to the weld are reamed to proper size.

The method of removing the tube area of the tube sheet when applying a superheater to a saturated engine is shown at *B*, Fig. 6. The tube sheet is cut across below the tube holes and the new top half flanged and fitted in place, leaving a 3/16-in. beveled opening across the bottom. Care is taken to have the ends of the old and new side flange butt tightly together so that the contraction of the cooling weld across the sheet will not pull the new sheet down from the top corners. After the cross weld is completed and cold, the ends of the side flanges are chipped bevel with a 3/16-in. opening and the welding completed.

In a firebox recently turned out for service by the writer there were two side sheets, one door sheet, one tube sheet patch on the top knuckle, one crown sheet patch under the T-bars and a door hole lap seam, all gas welded, making a total of 50 ft. 2 in. of welded seams in this one firebox.

In the tank department many economies are effected by autogenous welding. A method of building up worn faces of spring pocket castings is shown in Fig. 7, a new wearing face, formed of boiler plate, being electric welded as shown.

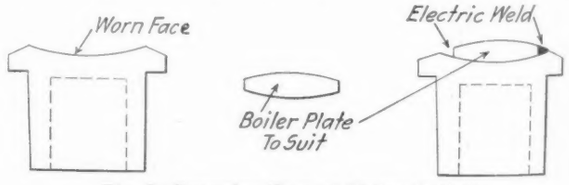


Fig. 7—Renewing Face of Spring Pocket

On castings where the wear is not enough to require the application of a plate the worn portion is built up by applying the metal electrode direct to casting. All castings are uniformly heated to a black heat before welding. This method is more expensive than machining off the face of the chafing casting to a new wearing surface, but constant machining soon causes scrapping of a casting, while the welding method saves it for further use.

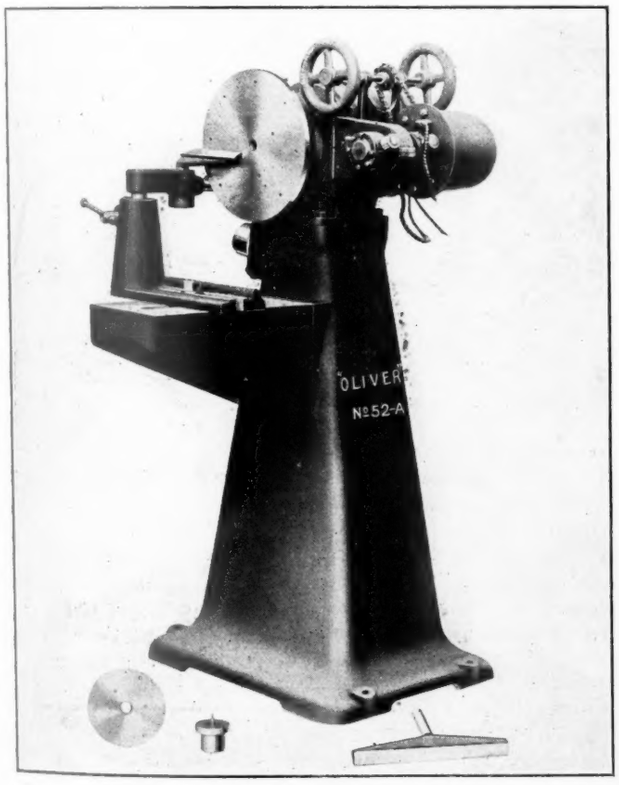
Drawbar pin holes in draw castings on tanks when worn out of round are built up where worn, using the metal electrode, and then rose reamed to the proper diameter. Coupler shanks and coupler carrier plates are reinforced where worn by using the electric arc welding process.

NEW DEVICES

OLIVER MOTOR HEAD FACE LATHE

A face lathe in the head of which the driving motor is incorporated has been placed on the market by the Oliver Machinery Company, Grand Rapids, Mich. The machine has a swing of 24 in. over the bracket, and 20 in. over the rest socket. It will turn work up to 12 in. wide by 20 in. in diameter, or 6 in. wide by 24 in. in diameter, and is a particularly useful tool for pattern shop work.

The machine is entirely self-contained. The motor head, the controller or switch and the rests are mounted on the floor column, making the machine especially adaptable as a portable tool. All electric parts are totally enclosed and dustproof. The equipment of the machine includes a 16-in. tool rest with an offset holder, one right-angle rest, one 6-in. and one 12-in. face plate and one 2¼-in. screw chuck.



Motor Head Face Lathe Fitted With Alternating Current Motor

The machine is fitted with either an alternating current or direct current motor, the illustration showing the rear view of the alternating current machine with the speed controller attached to the head. The alternating current motor head will run at 800 to 3,500 r. p. m., the speed being controlled by handwheels governing a self-contained controller. The alternating current motor is of the single-phase series-compensated type and will operate on any single or polyphase circuit of proper voltage. It will operate satisfactorily on any frequency from 25 to 60 cycles. The direct current motor head operates from 600 to 3,000 r. p. m. the controller in this case being mounted on the side of the floor column.

The armature or rotor shaft of the motor constitutes the headstock spindle of the machine. This spindle is of steel tubing 1¼ in. in diameter and has a ½-in. hole throughout its entire length to facilitate the removal of centers. The inside end is threaded for face plates and bored out to receive No. 2 Morse taper shanks. The outside end carries a handwheel for holding the spindle while removing the face plates, for turning the spindle by hand when making adjustments, or for quickly stopping the motor. When rear end turning is desired the handwheel may be replaced by a face plate.

A PNEUMATIC RIVET CUTTER

The increase in the amount of steel car repairing has created a need for a tool that will cut rivets quickly and cheaply. Knocking the heads off with a sledge hammer and set is hard work and the pneumatic hammer cannot be used satisfactorily unless the rivets can be reached easily. A tool especially designed for rivet cutting is now being made by the Rice Manufacturing Company, Indianapolis, Ind., known as the Red Devil rivet cutter. By its use it is claimed that ⅞-in. or 1-in. rivets can be cut with from three to five blows and 1¼-in. rivets in 10 seconds.

Pneumatic Rivet Cutter Especially Adapted for Use on Steel Cars

The device consists of a cold drawn seamless tube about 5 ft. long with suitable fittings hydraulically pressed into

each end. The rear end is fitted with a valve by means of which air is admitted into the tubes behind the plunger while it exhausts from the forward end into a rubber by-pass. By giving the valve a quarter turn air may be admitted into the by-pass at the forward end of the tube and exhausted from the rear. At the forward end there is a bushing designed to provide a fit for the end of the chisel bar. Inside the tube there is a plunger ground to fit with sufficient clearance to allow easy movement with a minimum amount of air leakage.

As shown in the photograph three men are required to operate the cutter. One stands at the forward end to guide the chisel while two carry the rear end by means of suitable handles, one of them manipulating the valve lever. After a little practice the workmen can operate the cutter either rapidly or slowly and can strike either heavy or light blows. Springs in each end of the tubes absorb the shock of the plunger so that it is not difficult to hold the device while in use. The best results are secured with an air pressure of 90 lb. per sq. in., although if desired the rivet cutter can be used with pressures as low as 40 lb. The total weight of the device in working order is 65 lb. and the total length is 58 in. Under average conditions three men operating this tool are said to cut from 25 to 33 times as many rivets as they could cut in the same time by hand. A smaller tool known as the Baby Devil is manufactured by the same company for use on rivets of ⅝ in. diameter and less. This machine is handled by two men instead of three.

SEMINOLE TOOL STEEL

Considerable thought has been given to the development of tool steels and great improvement has resulted from experiments with numerous alloys, but it has been characteristic of such steels that increased hardness resulted in an increased

Fig. 1—Seminole Steel Chisel Driven Through a 35 Per Cent Carbon Steel Block

brittleness and consequent loss of strength. This is a most important factor in chisel steel, which is subjected to sudden and severe stress from the blows of a hammer.

A tool steel having some unusual properties has been developed by the Ludlum Steel Company, Watervliet, N. Y., which has been given the trade name, "Seminole." It can be made so hard that it will cut glass, but will bend without fracture. Some of the possibilities of this steel are illustrated in Fig. 2, showing a piece ¼ in. by 1/16 in. that is extremely hard but has been bent so that the loop is less than 1½ in. in diameter. Fig. 3 shows a piece of the steel

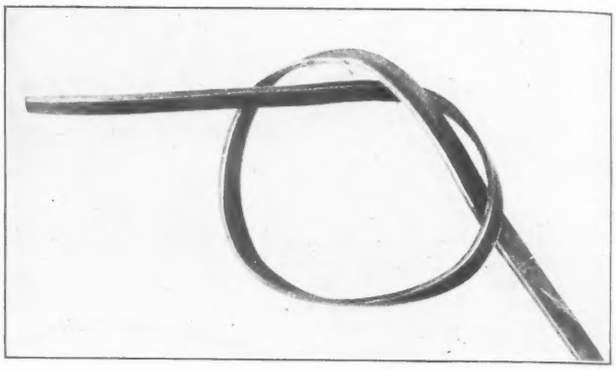


Fig. 2—A ¼-in. X 1/16-in. Piece of Seminole Steel

drawn to a point and driven three times through a low carbon steel bar without breaking. Fig. 4 shows a chisel that was driven through a block of .35 per cent carbon steel, bent over and straightened several times without breaking, and was then found hard enough to scratch glass. Fig. 1 shows a chisel of this steel driven through a .35 per cent carbon steel

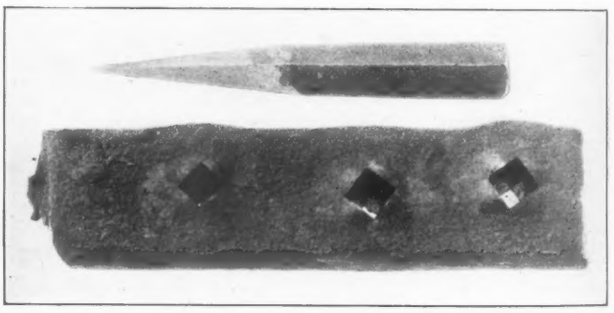


Fig. 3—Low Carbon Steel Bar Pierced by Chisel-Steel Spike

slab without bending the chisel or damage to its edge. All of these tests were made with tools and material cold.

This steel can be satisfactorily hardened in temperatures ranging from 1,650 to 1,950 deg. F., but the preferable range is considered to lie between 1,750 and 1,800 deg. After heating, the steel is quenched in oil and then slightly drawn. The drawing increases the toughness of the metal

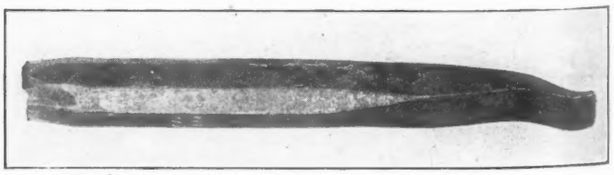


Fig. 4—Seminole Steel Chisel, Bent Several Times After Driving Through Steel Bar

without decreasing the hardness. Another desirable quality of this steel is that it does not sliver, thus eliminating a frequent cause of injury to users.

Photomicrographs taken at 400 magnifications show a very fine structure which tests have indicated is highly homogeneous.

AIRTIGHT ASH PIT DOOR FOR STATIONARY BOILERS

A perfectly tight ash pit door is essential to prevent combustion in the ash pit and also in preventing excess air from entering the firebox through some types of stokers. Plant economy and ease in handling ashes are features which should be carefully considered in choosing doors for the ash pits of power houses.

The American Steam Conveyor Corporation of Chicago and New York, specializing in all forms of ash disposal equipment is manufacturing the American ash pit door which has been produced as the result of careful tests and study, covering all points essential to successful operation and durability.

Experience has shown that an ash pit door should not be larger than is necessary to allow easy removal of ashes from the pit, as it is difficult to prevent a large door warping and thus leaking air and it is also too heavy to be handled easily. A 24-in. by 36-in. door is recommended as ample in size for the largest pit. Three other sizes, 18 in. by 18 in., 22 in. by 26 in., and 24 in. by 24 in. are also built of the same general design.

American Airtight Ash Pit Door with Hinges Arranged to Produce Uniform Pressure on the Frame

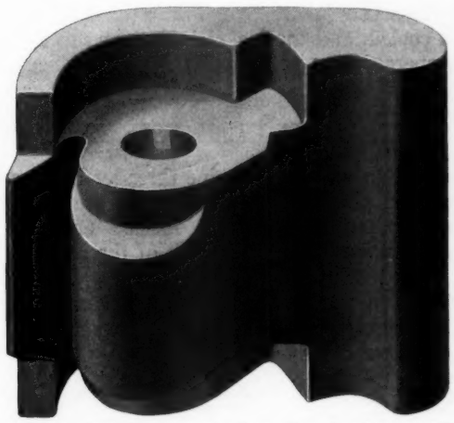
The door frame is of cast iron of ample strength for all conditions. It is of angle section, fits well back into the setting and is easily fastened into the pit wall by four bolts, one in each corner. The bearing surface is carefully machined. The hinge and locking lugs are cast on the frame and are of ample strength to meet the hard usage to which ash pit doors are subjected.

The door itself is of heavy cast iron and is provided with a heavy ventilated cast iron liner to prevent contact with the hot ashes and consequent warping. The bearing surface of the door is also carefully machined to make an airtight joint with the frame. Two hinges of the floating type with hinge bars pivoted to the frame carry the door at the center where it is pivoted to the bars. This gives a perfectly distributed pressure on the door and keeps a tight joint at all points with no possibility of a clinker in the corner of the frame opening, breaking or bending the door by a wedge action and also allows the door to be swung entirely out of the operator's way.

The door is easily, quickly and tightly locked by means of wing nuts at the end of the hinge bars, two locks being used for the 24-in. by 36-in. door and one lock for smaller sizes.

REX EMERGENCY KNUCKLE

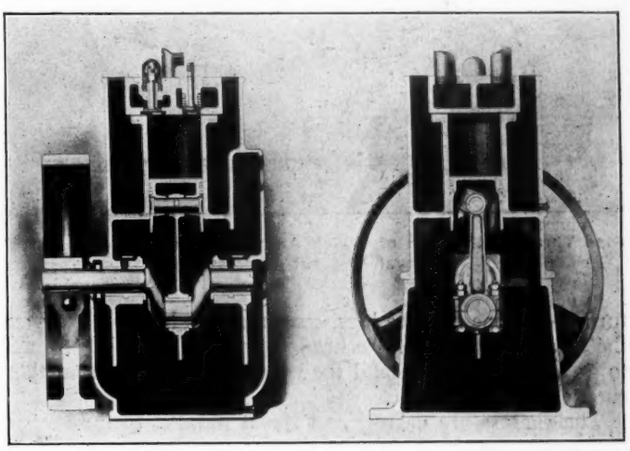
It has become common practice on American railroads to carry in cabooses so-called emergency knuckles. These devices can be applied in place of any standard knuckle in case of breakage, and are stronger than chains and easier to apply. The National Car Equipment Company, Chicago, is now manufacturing a new device of this type which is known as the Rex emergency knuckle. When applied it is held in place by the knuckle pin and by a rib extending over the side wall of the coupler. This makes it unnecessary to remove the locking device from the coupler before applying the emergency knuckle. The Rex emergency knuckle has the further advantages of being light and easy to apply, and its use does not increase the distance between cars. It has already been adopted by several important railroad systems.



Emergency Knuckle That Can Be Applied Without Removing Knuckle Lock

SMALL AIR COMPRESSORS

To meet the need of a small air compressor the Ingersoll-Rand Company, New York, placed its "Imperial Fourteen Compressor" on the market. These compressors are of simple, rugged construction and the design is very similar to that of an automobile engine, having the same type of drop forged crank shaft and con-



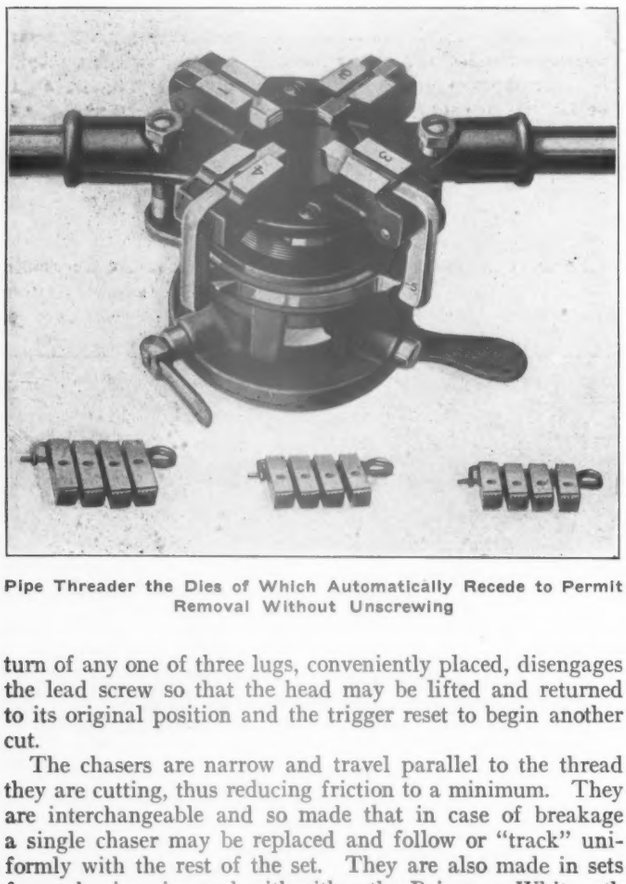
Sectional Views of Ingersoll-Rand Small Air Compressor

necting rod, die cast, renewable bearings, and automatic splash lubrication system. They are made in four sizes, ranging in capacity from 3 to 45 cu. ft. per minute at pressures up to 100 lb. per sq. in. The small compressors may be used for pressure up to 200 lb. per sq. in. by using a slightly increased horsepower. The machines are of the single acting, belt driven, vertical type, and may be bolted to any solid flooring, but for permanent installation a concrete foundation is preferable. The smallest size is built with an air cooled cylinder for intermittent service, or with a water cooled cylinder of the reservoir type for continuous operation. The larger sizes are built only with water cooled cylinders employing the reservoir jacket system, except for the largest size, for which a closed jacket for connection to a pressure system is optional.

In the reservoir jacket system both the cylinder barrel and head are cooled, and the jacket is designed to hold sufficient water to operate for a period of 10 hours with a single filling.

RECEDING PIPE THREADERS

A new design of receding pipe threader has recently been developed and placed on the market by the Greenfield Tap and Die Corporation, Greenfield, Mass. This tool is turned on the pipe until the desired length of thread is cut and can then be pulled off without turning back. At the beginning of the operation the chasers cut a full depth thread, and as the work progresses the levers supporting them gradually change their position, permitting the chasers to recede until they have completely withdrawn from the pipe, thus allowing the threader to be pulled off without the loss of time that would be required to unwind from the threads. A single



Pipe Threader the Dies of Which Automatically Recede to Permit Removal Without Unscrewing

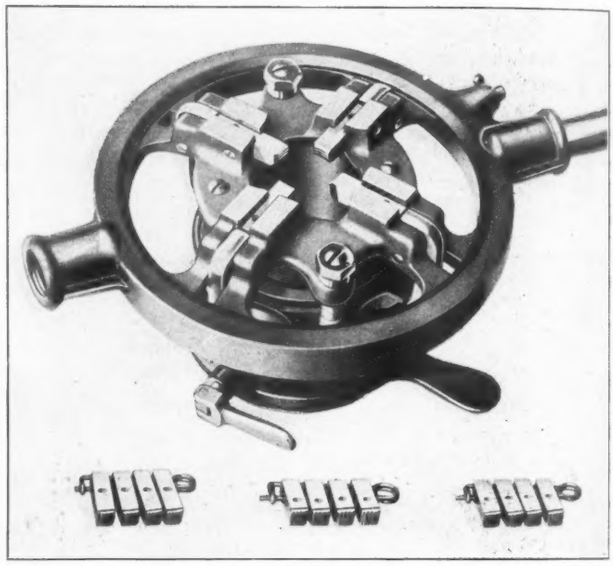
turn of any one of three lugs, conveniently placed, disengages the lead screw so that the head may be lifted and returned to its original position and the trigger reset to begin another cut.

The chasers are narrow and travel parallel to the thread they are cutting, thus reducing friction to a minimum. They are interchangeable and so made that in case of breakage a single chaser may be replaced and follow or "track" uniformly with the rest of the set. They are also made in sets for each pipe size and with either the Briggs or Whitworth thread.

The lead nut is in three segments, which are self-cleaning so that dirt or chips cannot gather on the lead screw, and both the lead screw and nut can be replaced without returning the tool to the factory. Adjustment for cutting shallow or deep threads is easily made by means of the lock nuts and adjusting rods that project through the head of the threaders.

A three-jawed universal chuck guide is provided, and after the jaws are tightened against the pipe one turn of a grip screw working inside the chuck, tightens it so it will not slip.

For threading pipe in trenches or other places where the space is limited, a threader of similar general design but



Ratchet Receding Threader

provided with a ratchet receding mechanism has been developed. The ratchet mechanism is incorporated in the die stock and has two handles, one of which may be detached, thus permitting the tool to swing in a 14-in. circle. This tool can also be used in the same manner as the other receder by disengaging the ratchet.

SELLERS INJECTOR INDICATOR

In the description of the Sellers injector indicator, published on page 218 of the April, 1919, *Railway Mechanical Engineer*, an error was made in the last sentence of the second paragraph. One-half-inch copper pipe is used to connect the upper end of the cylinder with the overflow chamber of the injector instead of ½-in. copper wire as incorrectly stated in the article describing the device.

EXPORTS FROM BRITAIN.—The British railway supply export figures for the whole year 1918 are given in the Board of Trade returns for December. They are as follows, the corresponding figures for 1917 being given in parentheses. Locomotives, $5,377,435 ($8,147,270); rails, $2,421,000 ($3,452,375); carriages, $2,807,380 ($825,880); wagons, $1,644,055 ($2,215,120); wheels and axles, $1,722,340 ($783,165); tires and axles, $3,098,795 ($2,697,645); chairs and metal sleepers, $820,450 ($368,410); miscellaneous permanent way material, $2,785,165 ($2,472,210); total permanent way, $6,105,475 ($6,319,630). The weight of rails exported was 26,335 tons (38,900 tons), and of chairs and metal sleepers, 10,173 tons (5,650 tons). Of the locomotive exports $147,950 ($1,138,850) in value went to South Africa and $1,237,050 ($882,965) to British India.

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WE GUARANTEE, that of this issue 9,220 copies were printed; that of these 9,220 copies, 7,656 were mailed to regular paid subscribers, 72 were provided for counter and news company sales, 192 were mailed to advertisers, 27 were mailed to employees and correspondents, and 1,273 were provided for new subscriptions, samples, copies lost in the mail and office use, that the total copies printed this year to date were 40,610, an average of 8,122 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.)

W. G. McAdoo, of New York City, former director general of railroads, has been appointed special counsel to the Railroad Administration on matters arising in the state of New York, to serve without pay.

Exports of locomotives in February, 1919, totaled 85 with a value of $2,584,269, as compared with 87 in January, 1919, valued at $3,076,543. Exports of car wheels and axles in the month of February, totaling $541,630, were double those of January, when exports of these commodities were made, which were valued at $278,393. Two hundred and twenty-five passenger cars were exported in February, valued at $130,768, and 583 freight and other cars, which were valued at $957,128.

For the purpose of meeting the emergency caused by the radical curtailment of the machinery of the United States Employment Service because of lack of funds, the Council of National Defense has announced the formation of an Emergency Committee on Employment for Soldiers and Sailors, including representatives of the various government departments. The chairman of the committee is Col. Arthur Woods, and the secretary will be E. H. Greenwood, who has been associated with the Department of Labor in its employment work. A representative of the Railroad Administration probably will be added to the membership of the committee.

The Pennsylvania Railroad is building an 11,000-volt power line from South Altoona to Altoona and is installing at that place the first unit in a centralized power station that will do away with the plants at Twelfth street, Fourth street and Juniata. These plants will be retained only to generate steam for heating and the operation of steam hammers. The installation of the new system, on which work is already well under way, will involve the placing of two 5,000-kw. generators and auxiliary machinery at the new South Altoona plant, the power line of all-steel construction, and sub-stations at South Altoona, Twelfth street, Fourth street and Juniata. At these places transformers will step down the current to the voltage needed to operate at that particular place. The change, which involves the expenditure of many thousands of dollars, will be completed in the early summer. Although the new system is being installed as a matter of economy, it will incidentally be a very material aid in lessening the smoke nuisance in Altoona.

Railroad Y. M. C. A. Campaign

Arrangements for the "Continental Extension Movement" of the Railroad Y. M. C. A., which is to be inaugurated on May 18, have been completed and the slogan "Couple Up" has been adopted. It is significant that the 300 associations in this country will act as a unit in this extension movement. Another important factor is that the railroad men themselves are taking the leadership in the movement, and the secretaries are being utilized largely in an advisory capacity. While efforts will be concentrated at the opening of the campaign to increase the membership, this is only a small part of the extension program. The summer months will be utilized for assimilating the new members and perfecting the general organization of the different branches and then early in the fall there will be a series of campaigns, each lasting one week, and each devoted to stirring up interest and developing plans for the year to cover the various phases of the work. For instance, there will be a religious week, a thrift week, a health and happiness week, educational week and Americanization week. It is expected that a very large number of new members will be drawn into the work and that active work will be carried on among employees who are not now served by the association.

Steel Price Situation

Little progress has been made in carrying into effect the schedule of steel prices announced in these columns last month as the outcome of a conference of the Industrial Board of the Department of Commerce with representatives of the steel industry. A controversy has arisen with Secretary Glass and the Railroad Administration on one side and the Department of Commerce and its Industrial Board on the other, which springs from a difference of understanding as to the function of the board, as well as over the price of steel. The Railroad Administration does not concede that the authority of the board goes so far as the arbitration of the question of prices, but that its function is merely that of a mediator to bring about agreement between the producers and government purchasing departments. The Railroad Administration takes the position that until a price was reached which would be satisfactory to it, the board had failed to accomplish its intended functions and it has never agreed to the schedule as announced. The result is that inasmuch as the Railroad Administration is the largest pur-

chaser of any of the government agencies, the proposed prices have little prospect of becoming established, especially so far as steel rails are concerned.

Members of Thirteenth Engineers Receive French Decoration

On February 22, 1919, thirty-one officers and men of the Thirteenth Engineers were awarded the Croix-de-Guerre. The decorations were presented at Simmeilles-Nettencourt by Colonel Boquet, Director General of Military Transports of the French armies. In bestowing the decorations upon the engineers, Colonel Boquet said in part:

"I am very happy to have been directed to hand today the Croix-de-Guerre, which it has been Marshal Petain's goodwill to award some of you in accordance with the proposals made by Lieut.-Colonel Marchand, Military Commissaire of the Eastern Railroad, and myself.

"These rewards you fully deserve for the untiring zeal and devotion you have shown. * * * I have known the 13th Regiment of American Engineers ever since their arrival in France. I have constantly watched their work and efforts, and I have, better than anyone else, been in a position to appreciate their valor and good spirit."

Those to whom the decoration was presented were:

Colonel N. L. Howard, formerly division superintendent on the Chicago, Burlington & Quincy, at Hannibal, Mo.

Lt. Col. C. E. Whiting, formerly division superintendent on the Chicago, Milwaukee & St. Paul, at Lewistown, Mont.

Major E. Schultz, formerly division master mechanic on the Chicago & North Western, at Chicago.

Captain W. Haberlaw, formerly roadmaster on the Chicago, Rock Island & Pacific, at Rock Island, Ill.

Captain J. W. Kern, formerly supervisor on the Illinois Central at Mounds, Ill.

Lieut. Hugh MacKee.

Lieut. H. Halverson, formerly roadmaster on the Chicago & North Western at Eagle Grove, Iowa.

Lieut. E. E. Deyo, formerly yardmaster on the Chicago Great Western at Oelwein, Iowa.

Lieut. R. Harrisson.
Lieut. L. A. Weary.
Master Engr. F. Williams.
Master Engr. B. Berryhill.
Sergeant L. Face.
Sergeant O. Olsen.
Sergeant H. Lightner.
Sergeant Thomas J. Ross.
Sergeant J. E. Morrell.
Sergeant W. N. MacMahon.
Sergeant A. G. Crozier.
Sergeant W. Dreasher.
Corporal C. T. Barnes.
Corporal W. Lish.
Corporal W. T. Mott.
Corporal M. H. Bootjer.
Private D. C. Steinmeyer.
Private V. Nicholls.
Private G. Tichy.
Private F. Bitte.
Private E. Vondeveld.
Private W. B. Muller.

MEETINGS AND CONVENTIONS

Tool Foremen's Association.—It has been decided to hold the ninth annual convention of the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, on August 27 to 29, 1919.

Convention of Master Tinners', Coppersmiths' and Pipefitters' Association.—The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association has announced that the next annual convention will be held on June 2, 3, 4 and 5, 1919, at the Marquette Hotel, St. Louis, Mo. The topics selected for discussion are as follows: Alloys of Soft Metal, George Hofford; Spot Welding in the Railroad Tinshop, A. Paulis; Light Gage Sheet Metals, Charles Borcherdt, chairman, and M. M. Byington; Pipe Threading, Cutting and Lubricating, F. J. Bucholtz, chairman, and J. G. Hunnicutt; Labor Saving Devices, C. E. Knight, chairman, and W. J. Moffatt; Commercial Iron and Steel Pipe and Copper Tubing, T. E. Holderby, chairman, W. E. Jones and J. F. Richards. The officers of the association are: President, W. J. Moffatt (N. Y. C.); first vice-president, G. B. Hofford (M. P.); second vice-president, W. W. Nash (I. C.); third vice-president, T. E. Holderby (C. & O.); secretary-treasurer, O. E. Schlink (C. & O. of Ind.)

Air Brake Association Convention.—The 26th annual convention of the Air Brake Association will open at 9:30 A. M., May 6, at the Hotel Sherman, Chicago, Ill. Frank McManamy, assistant director, division of operation, United States Railroad Administration, has issued a circular to the various regional directors, requesting them to send as many as possible of their air brake men to the convention, and from present indications the attendance this year will be greater than at any previous convention.

The complete list of subjects to be presented is as follows: (1) Air Consumption of Locomotive Auxiliary Devices, by C. H. Weaver and Committee; (2) Air Leakage and Money Wastage Through Failure to Keep Hose Couplings in Standard Gage, by the Manhattan Air Brake Club; (3) Recommended Practice; (4) M. C. B. Air Brake Defect Card; (5) Instructions on Freight Car Brake Maintenance; (6) Holding Standing Trains and Cars on Grades; (7) Damage to Air Brake Equipment by Thawing Plants, by the North West Air Brake Club; (8) Braking Ratio of About 40 Per Cent and Inside Release Valve for Caboose Car, by the North West Air Brake Club; (9) How Can Enginemen and Trainmen Assist in Air Brake Maintenance? (10) A Resumé of the Air Brake Supervisor's Responsibility to the Stores Department, by Montreal Air Brake Club.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 6-8, 1919, Chicago.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention, June 2-5, 1919, Marquette Hotel, St. Louis, Mo.

American Railway Master Mechanics' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention, August 27-29, Hotel Sherman, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreuccetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, New York, N. Y.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago. Convention May 19-22, 1919, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Convention September 2-5, 1919. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 26-29, Hotel Sherman, Chicago.

Master Car Builders' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 18-21, Atlantic City, N. J.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y.—Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Seretary	Address
Canadian	May 13			James Powell	P. O. Box 7, St. Lambert, Que.
Central	May 9	Railroad Power Plants	William Olsen	H. D. Vought	95 Liberty Street, New York.
Cincinnati	May 13	Fuel Conservation	D. E. Dick	H. Boutet	101 Carew Building, Cincinnati, O.
New England	May 13	Co-operation and Not Competition is the Life of Trade	George J. Burns	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	May 16	An Evening with Foreign Railway Men		H. D. Vought	95 Liberty Street, New York.
Pittsburgh	May 23			J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis				B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	May 19			A. F. Stuebing	750 Transportation Bldg., Chicago.

PERSONAL MENTION

GENERAL

M. K. BARNUM, assistant to general superintendent maintenance of equipment of the Baltimore & Ohio, with office at Baltimore, Md., has been appointed mechanical engineer for the corporation.

W. F. CONNAL has been appointed mechanical engineer of the Canadian National Railways, with office at Toronto, Ont., succeeding H. D. Cameron, resigned to enter other service.

J. E. McQUILLEN, mechanical superintendent of the Gulf, Colorado & Santa Fe, the Fort Worth & Rio Grande, the St. Louis-San Francisco & Texas, the Texas Midland, the International & Great Northern (from Spring to Fort Worth and the Madisonville branch), the Fort Worth Belt, the Fort Worth Union Passenger Station, and the Houston Belt and Terminal, has also been appointed mechanical superintendent of the Fort Worth & Denver, the Wichita Valley, the Missouri, Kansas & Texas (west of Whitesboro), the Wichita Falls & Northwestern, the Abilene & Southern and the Quanah, Acme & Pacific, with headquarters at Galveston, Texas.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

W. J. ORMSBY, general foreman in the locomotive department of the Illinois Central, with headquarters at Chicago, has been promoted to master mechanic of the Wisconsin division of the same road, with headquarters at Freeport, Ill., to succeed E. Lawless, deceased.

CAR DEPARTMENT

C. A. SASSE has been appointed divisional car foreman on the Pennsylvania division of the Delaware & Hudson, with headquarters at Carbondale, Pa., succeeding F. S. Ganley, assigned to other duties. Mr. Sasse will report to the master car builder.

OBITUARY

AMOS H. WATTS, who was master mechanic of the Cincinnati Northern, with office at Van Wert, Ohio, previous to July, 1912, died on March 30, at his home in Walnut Hill, Ohio, at the age of 72.

DAVID M. PERINE, special agent on the personal staff of the general superintendent of the New Jersey division of the Pennsylvania Railroad, with headquarters at New York, died on April 22 at Baltimore, Md., while on a business trip in that city. He was born on February 13, 1869, at Baltimore, Md., and entered the service of the Pennsylvania System in May, 1889, as an apprentice at the Mt. Vernon shops of the Northern Central. He subsequently served consecutively as assistant road foreman of engines, assistant master mechanic, assistant engineer of motive power, and master mechanic until April, 1906, when he was promoted to superintendent of motive power of the Northern Central and the Philadelphia & Erie. The following year he was transferred to Pittsburgh on the Western Pennsylvania division, and in January, 1912, was again transferred to the New Jersey division and the West Jersey & Seashore, as superintendent of motive power, remaining in that position until his promotion in June, 1917, as special agent on the personal staff of the general superintendent of the New Jersey division, as above noted.

SUPPLY TRADE NOTES

The Union Asbestos & Rubber Company of Chicago has moved its general offices from 112 West Adams street, Chicago, to 2834 South Loomis street.

The Standard Railway Equipment Company of New York, Chicago and St. Louis has moved its New York offices from the Singer building to the Equitable Trust building.

On April 1, 1919, the name of the Aspromet Company, Pittsburgh, Pa., manufacturers of asbestos protected metal, was changed to the H. H. Robertson Company.

The Pacific Car & Foundry Company, Seattle, Wash., has expended approximately $400,000 for new buildings, tools and equipment in refitting the car building plants situated at Renton, Wash., and Portland, Ore.

The Interstate Iron & Steel Company of Chicago has opened a branch office at Detroit, Mich., with R. B. Dutch in charge of sales in that territory. Mr. Dutch has been identified with the iron and steel industry for several years.

A. M. Mueller, manager of the St. Louis branch of Joseph T. Ryerson & Son of Chicago, has been promoted to general manager of sales, in which capacity he will have charge of all warehouse and mill products for all territory west of Pittsburgh. He was born at Plymouth, Ind., on July 30, 1874, and received his education in the public schools at that place. His business career dates back to 1899 when he first entered the employ of Joseph T. Ryerson & Son as a clerk in the credit and cashier department. During this period he served successively as traveling salesman, Texas representative for three years and manager of the New York and Minneapolis offices until 1911, when he was appointed assistant manager of sales. Later he went to St. Louis, Mo., as manager of the Ryerson-Hagar plant, being recalled at the end of three years to handle the sales at the main plant at Chicago.

A. M. Mueller

C. M. Schramm, chief clerk to the general mechanical superintendent of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been appointed assistant to the vice-president of the Vapor Car Heating Company at Chicago.

The Chicago Pneumatic Tool Company has discontinued its branch office at Wichita, Kan., and has transferred the stock from that place to Eldorado, Kan., where an office and warehouse have been established. A new office has also been opened by the company at Tulsa, Okla.

The Firth Sterling Steel Company, McKeesport, Pa., announces the removal of its New York and Boston warehouses to new quarters. The New York warehouse will henceforth be at 310 Hudson street and the Boston warehouse at 35

Oliver street. The latter was previously occupied by the company from 1873 to 1914.

The American Blower Company, Detroit, Mich., has purchased a plot of ground containing approximately 15 acres upon which it intends to build a new plant. Plans are now being prepared for the construction of a foundry on which work will be started in the near future.

F. J. Foley has been appointed general sales agent of the Railway Steel-Spring Company, with headquarters at New York. Mr. Foley's connection with the company dates from its organization in 1902. For the past eight years he has occupied the position of general superintendent.

The Chicago branch of the General Asbestos & Rubber Company, Charleston, S. C., has recently moved into new quarters at 14 North Franklin street, Chicago, the rapid growth of the business in Garco asbestos products having made the old quarters at 106 West Lake street inadequate.

Frederick G. Zimmerman, assistant secretary of Harry Vissering & Company and the Okadee Company of Chicago, has been appointed secretary, to succeed Marshall E. Keig, who has resigned to accept the office of assistant to the president of the Consumers Company at Chicago.

Frank Walsh Haskell, president of the Carborundum Company, Niagara Falls, N. Y., died April 2 at his winter home at Daytona, Fla. Mr. Haskell was born in Brooklyn, New York, in 1861, and was educated in the schools there and in Bloomfield, N. J. He was for a time in railroad service as a rodman in the engineer corps, which laid out the Chicago, St. Paul, Minneapolis & Omaha. In 1885 he moved to Pittsburgh and there affiliated himself with Henry C. Frick as secretary and treasurer of the Southwest Connelsville Coke Company, owned jointly by the Frick and Illinois Steel Companies. In 1897 he moved to Niagara Falls, representing the Mellon interests of Pittsburgh, and becoming president of the Carborundum Company, then in its infancy. This company under his leadership became the greatest abrasive manufacturing concern in the world. It is not generally known that at the request of H. C. Frick and E. H. Harriman in 1905 Mr. Haskell made the investigation of the Equitable Life Assurance Society, which later brought before the public the disclosure resulting in the entire change in the method of life insurance business in the United States. The Armstrong and Hughes Investigating Committees, so-called, were the subsequent results, their facts being largely based on Mr. Haskell's accomplishment.

F. W. Haskell

Ensign Donald Walker, U. S. Naval Aviation Corps, died in the Naval Hospital at Key West, Fla., April 7, as the result of a fall of an aeroplane, of which he was the pilot, at Miami, Fla., on April 1. He was the son of Edmund H. Walker, vice-president of the Standard Coupler Company and president of the Railway Supply Manufacturers' Association. Ensign Walker was a student at Yale University when he entered the aviation service last year. He was 21 years of age.

The Bailey Meter Company on May 1 moved its main office and factory from Boston, Mass., to Cleveland, Ohio. The Boston office, with H. D. Fisher as manager, is being retained to handle sales and engineering service work in the New England district. For the present, New York and Philadelphia districts will be covered from this office and all other districts will be covered from Cleveland.

The Liberty Steel Products Company, Inc., announces the appointment of J. M. Borrowdale as sales representative in the railroad department, with office at 1901 McCormick building, Chicago. Mr. Borrowdale was formerly superintendent of the car department of the Illinois Central and for the past two years was connected with the H. W. Johns-Manville Company, New York, as sales representative in their railroad department.

D. P. Lamoreux, general manager of the Pratt & Letchworth Company, Ltd., Brantford, Ont., has been elected vice-president of the Canadian Car & Foundry Company, Ltd. Mr. Lamoreux has been connected with the Pratt & Letchworth Company since October, 1916. He was born in Mayville, Wis., December 12, 1873. He received his education at the University of Wisconsin, where he took a course in civil engineering as a member of the class of 1895. After leaving college he spent two years in the maintenance department of the Milwaukee Northern Railway, and the California-Oregon Railway, and for the following three years was private secretary to the commissioner of the general land office at Washington, D. C. In 1900 he became associated with the Beaver Dam Malleable Iron Company and worked his way up through that organization until in 1913, when he left to take up another position, he was the company's general manager. During this period, also, he was on the executive and legislative committees of the Wisconsin Manufacturers' Association and for three years of this time, was also regent of the University of Wisconsin. In 1913 he entered the railway supply business in Chicago, and was connected with the Cleveland Steel Company and the Trumbull Steel Company. He became connected with the Pratt & Letchworth Company in November, 1916, as general manager.

D. P. Lamoreux

William H. Basse has been appointed manager of the Detroit, Mich., plant of the Joseph T. Ryerson & Son Company. Mr. Basse has been in the employ of this company since November, 1900, and for the past ten years has held various positions in the sales department at Chicago. In August, 1918, he was transferred to the Detroit office as acting manager of the Detroit plant, succeeding Ralph J. Stayman, who left the company temporarily to fill a war vacancy existing at the Chicago office and who later resigned.

The Oliver Machinery Company, Grand Rapids, Mich., in order to take care of increased business, has found it necessary to enlarge its Chicago office and has moved into new quarters at 810 Railway Exchange building, Chicago. G. C. Conklin, who for many years was connected with the factory at Grand Rapids, is in charge of the Chicago office as

district manager, and George C. Ramer, who had formerly been connected with the St. Louis office of the company, has been added to the sales engineering force in connection with the new Chicago office.

A merger has been effected of the Hess-Bright Manufacturing Company, the S K F Ball Bearing Company, the Atlas Ball Company and the Hubbard Machine Company, the new company being known as the S K F Industries, Inc., which will handle a comprehensive line of ball bearings, including the Hess-Bright deep groove type, S K F self-alining radial and thrust bearings and ball bearing pillow-blocks and shafting hangers. The principal office will be at 165 Broadway, New York, with branches at Boston, Philadelphia, Atlanta, Buffalo, Cleveland, Detroit, Cincinnati, Chicago and San Francisco.

F. V. Sargent, has been appointed district manager of sales of the Chicago Pneumatic Tool Company, Chicago, with headquarters at Boston, Mass., to succeed F. S. Eggleston, who has resigned. Mr. Sargent was born in Belmont, Mass., on December 15, 1881. He began his business career in 1905 with the Bethlehem Shipbuilding Company as drafting clerk, and later was in charge of the heat treatment department and physical laboratories. In 1914 he entered the sales department of that company, in which capacity he remained until he accepted the position as district sales manager of the Chicago Pneumatic Tool Company.

Colonel Robert Andrews, one of the pioneers in American railroad construction and a former president of the Safety Car Heating & Lighting Company, died at his home in East Orange, N. J., on April 7, in his 85th year. Colonel Andrews was born August 2, 1834, at Andrewsia, near Wilmington, Del. His early schooling was at the Episcopal Academy of Cheshire, Conn., where he graduated in 1849. He then entered Trinity College, Hartford, Conn., graduating in 1853, and in 1854 completed a course at the Polytechnic College, Philadelphia. He adopted civil engineering as a profession, beginning his career as assistant engineer, Union Canal & State Canals of Pennsylvania. His long career of railroad engineering began in 1857 as principal engineer of surveys and construction on the Sunbury & Erie. In 1859 he went to the South Pennsylvania Railroad as principal engineer of surveys until the outbreak of the Civil War, when he was made a major of the 2nd Regiment, Delaware Volunteers. He was advanced to the rank of colonel in 1863. At the close of the Civil War he was made principal engineer of the Saratoga & Hudson River Railroad from 1863 to 1865: division superintendent of the Toledo, Wabash & Western from 1865 to 1873; chief engineer of the same road from 1873 to 1875, and general superintendent and consulting engineer of the Wabash System from 1875 to 1884. Then for one year he was consulting engineer of the Wabash, St. Louis & Pacific, and in 1885 was made general superintendent and engineer of the Virginia Midland. In 1889 he left railroad service to take the position of vice-president of the Safety Car Heating & Lighting Company. In December, 1901, he was elected president of this company, and from May, 1907 to 1915, he was chairman of the board of directors.

Col. Robert Andrews

Captain C. A. Duntley, who recently received his honorable discharge from the army after serving as captain in the 27th Field Artillery, has been elected vice-president of the Duntley-Dayton Company, with headquarters in the Westminster building, Chicago. He was born in Chicago on October 21, 1892, and received his education in Armour Institute, Chicago, and at Cornell University, from which latter school he was graduated in 1914. Captain Duntley will have charge of the sales work of the pneumatic and electric tool department of the company.

A. L. Humphrey, whose election as president of the Westinghouse Air Brake Company, succeeding John F. Miller, was announced in these columns last month, has been connected with the Westinghouse Air Brake Company since 1903 when he was appointed western manager with headquarters at Chicago. He was born in Buffalo, N. Y., and his family moved to Iowa when he was less than a year old. At the age of 14 after the usual amount of country schooling he struck out for himself and engaged in various occupations. At the age of 22 he organized a general machine shop and foundry in Seattle which afterwards became the present Moran Iron Works. He then entered railroad service and became constructing division foreman of the Mojave division of the Central Pacific, then master mechanic and later superintendent of motive power of the Colorado Midland. At about this time he took an active part in politics and was twice elected to the Colorado House of Representatives and during his second term served as speaker of the House. He then went back to railroad service on the Colorado & Southern in 1899 and went to the Chicago & Alton in 1903 as superintendent of motive power, soon after which he was appointed western manager of the Westinghouse Air Brake Company at Chicago. He went to Pittsburgh in 1905 as general manager of the air brake works, and was elected a director of the company in 1909 when he was also given the dual position of vice-president and general manager, which he held ever since. When the Union Switch & Signal Company was taken over by the air brake company in 1916, Mr. Humphrey was also elected president of that corporation. In addition he has been active in an executive capacity in all the other interests associated with the Westinghouse Air Brake Company, such as the Locomotive Stoker Company, Pittsburgh; the National Brake and Electric Company, Milwaukee; the American Brake Company, St. Louis, and the Westinghouse Pacific Coast Brake Company, San Francisco. During the war the companies of which Mr. Humphrey is in charge accepted from the British and Russian governments, contracts for the manufacture of shrapnel and explosive shells as well as time fuses numbering approximately four to six million units and component parts of war material, involving the expenditure of about $20,000,000 which contracts had to

A. L. Humphrey

be completed in a specified time. Mr. Humphrey not only put up factory buildings, installed special machinery and created an entirely new and separate organization for the construction of this work, but he also finished the job on time without having a single piece rejected. When the United States entered the war Mr. Humphrey received for the Union Switch & Signal Company a contract to produce 4,100 aeroplane engines of the Le Rhone type. Besides his activity as a manufacturer, Mr. Humphrey also acted in a consulting and advisory capacity to the government in Washington on many committees and boards. He was industrial "staff expert" for Brigadier General C. C. Williams, chief of the Ordnance Department, he was a member of the committee on Labor of the Council of National Defense, as well as a member of the War Industries Board and the War Resources Committee in Washington. He is president of the Employers' Association of Pittsburgh and a director of the Chamber of Commerce. Besides the election of a president, the stockholders at the annual meeting elected the following board of directors: Ben V. Becker, James D. Callery, E. M. Herr, A. L. Humphrey, John F. Miller, John R. McCune, John R. McGinley, Charles McKnight, M. S. Rosenwald, W. D. Uptegraff and H. H. Westinghouse.

E. I. du Pont de Nemours & Co., Inc., announces the organization on April 1, 1919, of E. I. du Pont de Nemours Export Company, a subsidiary corporation, created for the purpose of handling foreign business. The officers of the new company are as follows: F. W. Pickard, president; W. S. Gavan, vice-president and director of sales; F. D. Brown, treasurer; Alexis I. du Pont, secretary. The same staff which has previously been associated with the du Pont export business will be continued with some additions made necessary by the broader scope of the new corporation. The main offices will be located at 120 Broadway, New York, with branches in San Francisco, Mexico City, London and Rio de Janeiro.

Lieutenant Commander H. J. Elson, U. S. Naval Reserve Force, has been released to inactive status and has resumed his civilian work as secretary and treasurer of the Walter A. Zelnicker Supply Company, St. Louis, with which company he was in charge of internal management and manufacturing operations. Lieutenant Commander Elson was graduated from the U. S. Naval Academy in 1898, and after service in Cuba, the Philippines and China, resigned from the navy in 1902 to become interested in the Zelnicker company. He was chief engineer of the Missouri Naval Militia, with which organization he was mobilized into federal service upon the declaration of war, April 6, 1917. His assignment was as inspector of machinery, 9th, 10th and 11th Naval Districts, with headquarters at Chicago.

The American Steam Conveyor Corporation, Chicago, announces the appointment of Charles H. Florandin, formerly of the National Electric Welding Company, New York, as general manager of the eastern territory, with headquarters at the New York office, 110 West 40th street. Mr. Florandin was born in France and received his technical education at the famous Lycee de Marseilles. He is an engineer by profession, and upon coming to the United States did important work with the Brooklyn City Railway in the early days when the road was being electrified. After five years' service with this company, he joined the C. & C. Electric Company, New York, where he held a responsible position with them for many years. After a brief connection with the Western Electric Company, he returned to the C. & C. Electric Company, and later organized the National Electric Welding Company. During the war Mr. Florandin was a member of the welding committee of the Emergency Fleet Corporation.

Catalogues

Pneumatic Hammers.—Bulletin 101 has been issued by the Duntley-Dayton Company, Chicago, this being the first of a series of publications which this company has in preparation. It is devoted to the Duntley-Dayton line of riveting and chipping hammers, of which there are 20 sizes and styles, and features their low cost of maintenance. Pneumatic holders-on, pneumatic rammers, rivet sets, chisel blanks, hose, hose couplings, grease and oil, and lead hammers for use in repairing pneumatic tools, are also presented.

Motor Drive.—A universal motor drive for any kind of double spindle shaper has recently been developed by the Oliver Machinery Company, Grand Rapids, Mich., and this company has now printed a bulletin fully describing and illustrating the device and showing its advantages. It also includes a drawing showing the floor plan of the motor drive operating in connection with the Oliver No. 483 high speed double spindle shaper. A description of this device was published in the February, 1919, issue of the *Railway Mechanical Engineer*, page 107.

Air Transport System.—The Quigley Furnace Specialties Company, New York, has developed a system of carrying pulverized fuel which differs from screw conveyor and high pressure blast systems in that the fuel is transported in bulk from the pulverizing plant through small diameter standard wrought iron or steel pipe by compressed air to bins at the furnace, without the use of return piping. This system and the various apparatus used for the transport, distribution and burning of the fuel is described and shown in a diagrammatic drawing in Bulletin No. 11, containing 14 pages.

The Unit Car.—A steam propelled car, designed for railroad interurban and branch line service, known as the Unit car, is described in an attractive booklet containing 16 pages, issued by the manufacturer, the Unit Railway Car Company of Boston, Mass. As the name of the car indicates, its power plant, passenger and baggage space is combined in one car and it has been operated successfully and demonstrated its adaptability for satisfactorily handling short line traffic. The text is illustrated with photographs of the car and drawings showing the side elevation, floor plan and front end.

Cranes for Shops, Roundhouses and Yards.—The Whiting Foundry Equipment Company, Harvey, Ill., has recently issued catalogue No. 135 superseding catalogue No. 127. This catalogue describes electric, pneumatic and hand power traveling cranes, locomotive and coach hoists, gantry traveling cranes, jib cranes and pillar cranes. It gives a general description not only of the cranes but also of the details such as cabs, trucks, brakes and electric equipment, and discusses the field where the various types may be used to advantage. The illustrations show numerous typical installations on railroads.

Ash Disposal.—The American Steam Conveyor Corporation, New York, has issued a 160-page book on modern methods used in handling ashes in power plants. The first 32 pages are devoted to an exposition of the various methods in common use for the handling of ashes, including manual labor and the various mechanical and "current" methods. The remainder of the book is devoted to an explanation of the steam-jet conveyor method and its application to various types of boilers and furnaces together with a large number of descriptions and illustrations of actual installations of this equipment for office buildings, factories, railroads, etc.